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AND

MAGAZINE OF NATURAL HISTORY,

INCLUDING

ZOOLOGY, BOTANY, AND GEOLOGY.

(BEING A CONTINUATION OF THE 'ANNALS' COMBINED WITH LOUDON AND CHARLESWORTH'S 'MAGAZINE OF NATURAL HISTORY.')

CONDUCTED BY

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"Omnes res creatæ sunt divinæ sapientiæ et potentiæ testes, divitiæ felicitatis humanæ:—ex harum usu *bonitas* Creatoris; ex pulchritudine *sapientia* Domini; ex œconomiâ in conservatione, proportione, renovatione, *potentia* majestatis elucet. Earum itaque indagatio ab hominibus sibi relictis semper æstimata; à verò eruditis et sapientibus semper exculta; malè doctis et barbaris semper inimica fuit."—LINNÆUS.

"Quel que soit le principe de la vie animale, il ne faut qu'ouvrir les yeux pour voir qu'elle est le chef-d'œuvre de la Toute-puissance, et le but auquel se rapportent toutes ses opérations."—BRUCKNER, *Théorie du Système Animal*, Leyden, 1767.

. . . . The sylvan powers
Obey our summons, from their deepest dells
The Dryads come, and throw their garlands wild
And odorous branches at our feet; the Nymphs
That press with nimble step the mountain-thyme
And purple heath-flower come not empty-handed,
But scatter round ten thousand forms minute
Of velvet moss or lichen, torn from rock
Or rifted oak or cavern deep: the Naiads too
Quit their loved native stream, from whose smooth face
They crop the lily, and each sedge and rush
That drinks the rippling tide: the frozen poles,
Where peril waits the bold adventurer's tread,
The burning sands of Borneo and Cayenne,
All, all to us unlock their secret stores
And pay their cheerful tribute.

J. TAYLOR, *Norwich*, 1818.

ALERE FLAMMAM

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THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[FIFTH SERIES.]

"..... .... per litora spargite muscum,
Naides, et circum vitreos considite fontes:
Pollice virgineo teneros hic carpite flores:
Floribus et pictum, divæ, replete canistrum.
At vos, o Nymphæ Craterides, ite sub undas;
Ite, recurvato variata corallia trunco
Vellite muscosis e rupibus, et mihi conchas
Ferte, Deæ pelagi, et pingui conchylia succo."

N. Parthenii Giannettasii Ecl. 1.

No. 61. JANUARY 1883.

I.—*What is to be understood by the Term "Deep-sea Fauna," and by what Physical Conditions is its Occurrence governed?* By Prof. T. Fuchs*.

The great depths of the sea are peopled by a peculiar fauna, which is characterized by the occurrence or predominance of certain species, genera, and families, and presents a very similar constitution over the whole earth, so that a collection of deep-sea animals from any given part of the earth may be immediately and easily recognized as such.

The following may be regarded as the most striking and characteristic types of the deep sea:—

Oculinidæ. }
Cryptohelia. } So-called deep-sea corals.
Solitary corals. }
Brachiopoda.
Vitreous sponges (Hexactinellidæ).
Crinoidea (*Pentacrinus, Rhizocrinus, Hyocrinus, Bathycrinus*).
Echinothuriæ. }
Pourtalesiæ. } Echinida.
Ananchytidæ. }
Brisinga.
Elasmopodia (a peculiar suborder of Holothuriæ).
Ribbon-like fishes (Lepidopidæ, Trachypteridæ, Macruridæ, Ophidiidæ).

* Translated by W. S. Dallas, F.L.S., from the 'Verhandlungen der k.-k. geologischen Reichsanstalt,' 1882, no. 4, pp. 55–68.

The passage of the littoral into the deep-sea fauna is not effected suddenly and without transitions, but gradually, the different littoral animals ceasing and the different deep-sea animals commencing at different depths.

In this way a number of zones of depth may be distinguished between the shore-line and the greatest depths, each of them characterized by a definite assemblage of animals; and hence at the first glance it appears to be very much a matter of arbitrary choice where we draw the boundary between littoral and deep-sea faunas.

But when we go thoroughly into the matter, and in so doing take into account not so much the distribution of individual species or classes, as the distribution of the animals in its great fundamental features, we arrive at the conviction that this apparent indefiniteness really by no means exists, but that there is rather a perfectly definite region in which a change in the fundamental features of the fauna is effected, so profound and general, that in comparison with it all other subdivisions appear to be only divisions of subordinate rank.

The facts upon which this view is based are as follows:—

It is well known that marine plants, and indeed both sea-weeds and the Phanerogamia of the sea, as organisms dependent upon light, only extend down to a moderate depth in the sea; indeed we may in general fix this limit at the depth of 30 fathoms*. These submarine forests and meadows of marine plants, however, are the seat of an exceedingly rich fauna; and a great part of this has its existence dependent upon these plants, and is therefore bound to them in its occurrence.

A second prominent shallow-water assemblage of animals is presented to us in the coral-reefs. The reef-building corals attain the maximum of their development in a zone from 1 to 8 fathoms. Lower down they decrease perceptibly; and a depth of 20 fathoms is generally regarded as their extreme limit. The coral-beds, however, are also the gathering-grounds of an extremely rich fauna; and the animals composing this are at the same time often so remarkable and peculiar, and so closely connected in their occurrence with the coral-banks, that we may characterize them at once as reef- or coral-animals as, indeed, one sometimes speaks in this sense of coral-fishes, coral-mollusks, &c. The unparalleled wealth of marine animals which is displayed by the tropical part of the Indian

* Only Nullipores extend into greater depths, and are found, for example, in the Mediterranean, according to Carpenter, down to 150 fathoms.

and Pacific oceans is for by far the greater part connected with the coral-reefs. If we imagine the coral-reefs with their characteristic population to have disappeared, the Indian and Pacific oceans would at one blow lose the whole splendour of their animal life, and we should, instead of it, have before us a comparatively poor and insignificant fauna.

A third important element of the littoral fauna consists of the beds of large bivalves, such as oysters, pearl-oysters, scallop-shells, &c. These shell-beds appear generally to find the maximum of their development in from 8 to 10 fathoms, and no longer to occur below 20 fathoms. These shell-beds, however, also attract many other animals, especially Ascidians, worms, and starfishes, which likewise form a definite association of animals, and in part are specially attached to this dwelling-place.

The seaweed-forests, coral-reefs, and shell-beds with their inhabitants constitute the three most important animal-assemblages of the littoral region; and we may say, without exaggeration, that fully two thirds of the whole of the littoral marine animals are more or less intimately connected with one or other of these three assemblages. But as the seaweed-forests as well as the coral-reefs and shell-beds are confined to a depth of less than 30 fathoms, it follows directly that the great majority of the littoral animals cannot descend much below 30 fathoms in the sea.

A second point that we have to bear in mind is the fact that over the whole earth, at a depth of from 90 to 100 fathoms, almost all the important types of the deep-sea fauna are already represented, and the fauna already bears quite indubitably the character of the deep-sea fauna.

The celebrated Pourtales Plateau on the coast of Florida, so exceedingly rich in deep-sea animals, begins at a depth of 90 fathoms, from which it descends gradually to 300 fathoms, but without essentially changing its fauna in this further course; and the grounds near the island of Barbadoes, which are so rich in deep-sea animals, are also situated at a depth of from 80 to 100 fathoms. But at both these points we not only find an astonishing abundance of deep-sea corals (over sixty species have already been described), but there are already in great plenty and variety true vitreous sponges (Hexactinellidæ), besides deep-sea Crustacea, Arctic Asterida, *Echinothuriæ*, *Pourtalesiæ*, and no fewer than four pedunculate Crinoids (*Holopus*, two *Pentacrini*, and *Rhizocrinus**).

* Of Mollusca there are near Barbadoes at this depth:—*Cadulus sauridens*; *Dentalium disparile*; *Margarita asperrima*; *Calliostoma Bairdii*: *Mi-*

The ground upon which the *Euplectellæ* are fished near the Philippines does not lie deeper than 100 fathoms. That on the Scandinavian and English coasts, and no less in the Mediterranean, a well-marked deep-sea fauna prevails at a depth of 100 fathoms, has long been known from the researches of Sars, M'Andrew, Barrett, Forbes, and many others; and the same phenomenon has been observed wherever such investigations have hitherto been undertaken.

If we sum up the preceding statements, we find that the great mass of the littoral animals do not descend in the sea much beyond 30 fathoms, and, on the other hand, that at a depth of 90 fathoms the fauna already everywhere shows the marked type of the deep-sea fauna.

Between these two limits, *i. e.* between 30 and 90 fathoms, then, the passage from the littoral to the deep-sea fauna must be effected; and the question now arises whether we are in a position to lay down a more exact boundary within this zone. I believe that this is really possible, and, indeed, that we may find data for this purpose in the fact that, almost everywhere on the surface of the earth, the first forerunners of the deep-sea fauna are found at a depth of about 50 fathoms, consisting generally of deep-sea corals and Brachiopods.

On the coasts of Norway, according to M'Andrew and Barrett, the Brachiopoda commence in about 30 fathoms, and the deep-sea corals about 60 fathoms.

On the English coasts Forbes fixes the commencement of the zone of deep-sea corals at 50 fathoms.

On the French coast, in the Bay of Biscay, the deep-sea corals and Brachiopoda commence, according to Fischer, at about 31 fathoms.

In the Mediterranean the coral-grounds with the Brachiopoda commence, on the average, at 50 fathoms (according to Forbes at 55 fathoms in the Ægean).

On the coast of Florida, the first deep-sea corals appear, according to Pourtales and Agassiz, at a depth of about 40 fathoms; and from this point they increase rapidly with the depth, so that in about 100 fathoms, on the above-mentioned Pourtales Plateau, they are met with most abundantly developed.

On the coast of Brazil the 'Hassler' expedition found numerous deep-sea corals at a depth of 30–40 fathoms; and

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crogaza rotella; *Verticordia ornata*, *acuticostata*, and *Fischeriana*; *Poromya granulata*; *Neæra granulata*, *rostrata*, and *Tiffrupii*; *Crenella decussata*; *Nucula crenulata*; *Leda messanensis*, *Carpenteri*, and *vitrea*; *Terebratulina Caulleti*; *Terebratula cubensis*; *Eudesia floridana*; *Cistella Barrettiana*; and *Thecidium Barretti*, Dall.

the remarkable deep-sea corals from the Philippines described by Semper were obtained by him from a depth of about 40 fathoms.

In this connexion the numerous lists of local coral-faunas which Studer gives, founded on the rich coral-material collected by the 'Gazelle,' are very interesting*. Whenever he cites a locality which is below 40 fathoms, we may be sure that the coral-fauna bears the character of the deep-sea Corals.

This long series of facts from different seas therefore indicates very accordantly a depth of about 50 fathoms as that critical zone in which is situated the great turning-point that separates the littoral from the deep-sea fauna; and we are therefore justified in regarding the line of 50 fathoms as an ideal boundary between the littoral and the deep-sea fauna.

It is very interesting to observe that this depth is pretty nearly the same in all seas. Between the tropics, however, the separation of the littoral and deep-sea faunas, on the principle here adopted, seems to be not only ideal, but to a certain degree real. Thus, according to the observations at present extant, it would appear that within the tropics, below a depth of 30 fathoms, there follows an extremely sterile region with few animals, and that a more abundant fauna recurs only in proportion as, with increasing depth, true deep-sea animals begin to make their appearance in great variety at 80 and 90 fathoms. Consequently within the tropics the littoral fauna would be separated from the deep-sea fauna by a comparatively sterile region, extending about from 30 to 90 fathoms.

In the temperate and cold seas such an intermediate zone is unknown. Here, on the contrary, the two faunas intermingle very plentifully at their boundary-line, and thus produce a very great abundance of animals precisely in this critical boundary region.

In this way it is explained why, as Nordenskiöld has again quite recently indicated, there is in temperate latitudes a much greater abundance of animals at a depth of 40, 50, and 60 fathoms than the tropical seas present at the same depth.

If, then, founding upon the preceding statements, we regard the depth of 50 fathoms as the boundary between the littoral and deep-sea faunas, the question next arises, by what physical conditions this boundary-line is determined, and what, consequently, is the true conditioning cause of the appearance of the deep-sea fauna.

When the study of the bathymetric distribution of organ-

* "Verzeichniss der auf der Weltumsegelung der 'Gazelle' gesammelten Anthozoen," Monatsber. Berlin. Akad. 1878, p. 676.

isms commenced, it was so much the custom to regard conditions of temperature as the efficient factor, that, without further consideration, it was employed for the explanation of the bathymetric distribution of marine animals; and as it was found that in the sea the temperature diminished with increasing depth, and as it was further observed that some animals which are found only in the depths in the warmer seas, occur in the littoral region in the boreal and arctic seas, people became so thoroughly convinced of the truth of this opinion, that even at the present day we find the temperature almost universally regarded as the limiting factor, governing not only the horizontal, but also the bathymetrical distribution of marine organisms*.

Now it certainly cannot be denied that every individual species of animals is confined within certain limits of temperature, within which alone it finds the possibility of continued existence; and so far the limiting influence of the conditions of temperature certainly cannot be denied. But, true as this may be, it is equally certain, on the other hand, that the universal contrast that we find over the whole globe between the littoral fauna, on the one hand, and the deep-sea fauna, on the other, is in no way connected with the conditions of temperature, and must be brought about by some quite different conditions.

Dana has already repeatedly and emphatically pointed out that temperature plays only a very subordinate part in the distribution in depth of sea-animals†; and the facts which may be cited in favour of this are of so convincing a nature that one cannot help wondering how such an opinion as the above could so long prevail.

The reef-forming corals require in order to thrive an average temperature of 23°–25° C. (73°–77° F.); and it should never fall below 20° C. (68° F.). But, according to recent investigations, throughout almost the whole of the tropical part of the Pacific Ocean a temperature of 25° C. prevails at a depth of 80 fathoms, and of 21° C. (70° F.) down to 100 fathoms; and consequently, so far as it depends upon temperature alone, the reef-building corals, with the whole wealth of their fauna, might occur nearly to 100 fathoms. Never-

* Thus, even quite recently, in the general introduction to the zoological publications of the 'Challenger' expedition, Thomson treated temperature as the most important factor in the distribution of marine animals in depth.

† See, for example, Dana, "On the question whether Temperature determines the Distribution of Marine Species of Animals in Depth" (Amer. Journ. vol. xv. 1853, p. 204).

theless it is well known that they cannot well go below 8–10 fathoms, and that they are never met with living below 20 fathoms.

In the Red Sea a temperature of 21° C. prevails down to the bottom at a depth of 600 fathoms, and consquently tropical organisms might occur down to a depth of 600 fathoms. But, so far as we are yet acquainted with the characters of the Red Sea, this appears to be by no means the case; and with regard to the coral-reefs and their fauna we know with certainty that in general they do not extend further down here than elsewhere, *i. e.* 8–10 fathoms, and that living reef-corals are never found below 25° C.

There is also another fact which is equally convincing. In the Polar seas there prevails perennially, from the surface down to the greatest depths, a uniform temperature of about 0° C. (32° F.), which only rarely rises 1° or 2° higher, or falls to about the same extent. If, now, the temperature were the limiting factor in the bathymetrical distribution of organisms, we ought properly, in the Arctic and Polar seas, to meet with the deep-sea fauna in the littoral region, and here that contrast between the littoral and deep-sea faunas which prevails in the warmer seas could by no means occur. As is well known, however, none of these suppositions are correct. In the littoral region of the Arctic and Polar seas we find no traces of deep-sea Corals and Brachiopoda, of vitreous sponges, *Echinothuriæ*, and *Pourtalesiæ*, no trace of Crinoids, *Brisingæ*, Elasmopodia, or of that swarm of remarkable Crustacea and fishes which characterize the deep-sea fauna. All these forms of animals occur, indeed, in the Arctic seas, but here also always only in the deep water, and not in the littoral region; and here the general contrast between the littoral and deep-sea faunas is just as sharply defined, and in the same manner, as in warmer seas.

It is true, indeed, as already stated, that there are some species of animals which, in warm seas, are found only in deep water, but which occur in shallow water in the Arctic seas; but their number is so inconsiderable, and they are at the same time so uncharacteristic, that they in no respect merit the importance which has hitherto been ascribed to them. It must also be noticed that very many of those so-called "arctic" animals which are found at great depths in southern latitudes only bear the designation "arctic" because they were first known from the Arctic seas; but that even here they by no means occur in the littoral region, but are also confined to the deep water as in warmer seas. Moreover there are also a number of species of animals which are found in warmer

seas in shallow water, and in the Arctic seas only in the depths*.

Further proofs of the small influence that temperature exerts upon the bathymetrical distribution of organisms are obtained if we examine into the occurrence of the deep-sea fauna at different points.

In the Arctic Sea, between Norway, Iceland, and the Faröes, we find at the bottom a temperature of from $-1°$ to $-2°$ C. (30°·2 to 28°·4 F.). Notwithstanding this low temperature, the fauna there is extraordinarily rich, and consists of the ordinary characteristic deep-sea forms. We find in great abundance deep-sea corals (*Lophohelia*, *Amphihelia*, *Caryophyllia*, *Flabellum*, *Umbellularia*), Brachiopoda (*Terebratula septata*, *Platydia anomioides*, &c.), vitreous sponges, *Echinothuriæ*, *Pourtalesiæ*, starfishes, Ophiurans, Crustacea, and the usual Mollusca of the deep sea.

Not far removed from this region, to the north-west of Scotland and Ireland, the bottom shows a temperature of 6°·5 to 8°·5 C. (43°·7 to 47°·3 F.) in exactly the same depth as before. But although the temperature here is only 8° to 10° C. (14° to 18° F.) higher than in the preceding case, the fauna still shows exactly the same character. Here, again, we find the same genera (*Lophohelia*, *Amphihelia*, *Caryophyllia*, *Flabellum*, *Umbellularia*), and we also find Brachiopoda, vitreous sponges, *Echinothuriæ*, *Pourtalesiæ*, together with perfectly similar starfishes, Ophiurans, Crustaceans, and Mollusca; nay, to a great extent even the species are the same in both regions.

On the Pourtales Plateau there is a temperature of from 7° to 13° C. (44°·6 to 55°·4 F.); and a temperature of at least 13° C., and probably considerably more, must prevail upon the deep-sea bottoms near the island of Barbadoes, upon which, as upon the Pourtales Plateau, the above-mentioned rich deep-sea fauna is found.

The Mediterranean, as is well known, in the same way as the Red Sea, presents abnormal conditions of temperature, the water from a depth of about 200 fathoms to the bottom

* Semper ('Die naturlichen Existenzbedingungen der Thiere,' in English under the title of "The Natural Conditions of Existence as they affect Animal Life,' 1881) particularly calls attention to this remarkable phenomenon, and endeavours to explain it by the hypothesis that the animals in question require not so much a definite *degree* of temperature as a *uniform* temperature. But a uniform temperature is found in the warm seas at a less depth than in the colder temperate seas. Sars also has quite recently called attention to this phenomenon ('Mollusca regionis arcticæ Norvegiæ:' Christiania, 1878).

possessing a uniform temperature of from 12° to 13° C. (53°·6 to 55°·4 F.). Nevertheless it possesses a perfectly well-marked and tolerably rich deep-sea fauna; for besides the multifarious deep-sea corals, Brachiopoda, and various deep-sea Mollusca which were previously known, a whole series of true deep-sea animals not previously known from this sea were discovered in the course of last summer (1881) by the dredging-expedition of the French ship 'Travailleur' *, such as several vitreous sponges (*Tetilla, Holtenia*), deep-sea starfishes (*Archaster bifrons, Asterias Richardi*), the genus *Brisinga*, and numerous deep-sea Crustacea (*Dorhynchus, Geryon, Ebalia, Ethusa, Munida, Lophogaster, Galathodes*), several of which are blind.

On the *Euplectella*-grounds which occur at a depth of 100 fathoms near the Philippines, the temperature, according to Semper, is 15° C. (59° F.), and off the island of Cebu, according to Moseley, even 21° C. (69°·8 F.)†. A fauna of precisely similar character and exactly similar composition occurs, however, as already mentioned, in other places at a temperature of 0° C., and still lower.

If we once more glance over what has just been stated, taking it in connexion, it becomes so clear that the occurrence of the deep-sea fauna is in no way connected with the temperature of the water, that it would be superfluous to point this out again expressly. But if it is not the temperature that causes the appearance of the deep-sea fauna, what is the condition governing it?

The chemical characters of the water, the amount of absorbed air contained in it, or the movement of the water have been suggested; but not one of these conditions seems to agree with the existing circumstances. The chemical characters of sea-water show no essential differences from the surface to the bottom. The amount and relative composition of the absorbed air certainly present some alteration with increasing depth; but this alteration is scarcely of any consequence at a depth of 50 fathoms, and could only exert a perceptible influence much lower down.

As regards the movement of the water, if we only take into consideration the wave-movements produced by storms, the circumstances appear at the first glance rather more

* Milne-Edwards, "Compte rendu sommaire d'une exploration zoologique faite dans la Méditerranée à bord du navire de l'état 'Le Travailleur'" (Comptes Rendus, 1881, p. 870); translated in Ann. & Mag. Nat. Hist. ser. 5, vol. ix. p. 37.

† Besides *Euplectellæ* and other vitreous sponges, the following Echinodermata also occur off Cebu at the above depth:—*Salenia hastigera, Aspidodiadema tonsum, Micropyga tuberculatum, Asthenosoma pellucidum*!

favourable, as, in fact, the wave-movement produced by violent storms makes itself perceptible, according to the prevailing opinion, down to a depth of about 50 fathoms; and even elsewhere the influence of the motion of the water upon the fauna is not to be denied. But on closer examination the thing seems extremely improbable. For instance, if the littoral fauna were connected with the motion of the water, we ought to observe an ascent of the deep-sea fauna in quiet bays, which, however, is by no means the case. But, on the other hand, we must consider that the great currents of the sea descend much deeper than the littoral fauna, and, indeed, the Gulf-stream especially is inhabited by the deep-sea fauna in its depths.

But if it be neither the temperature, nor the chemical conditions, nor the movements of the sea that regulate the bathymetrical distribution of marine animals, there remains in reality only one factor that can be taken into consideration; and this is *light.*

Light is the most powerful factor amongst all the agents which influence life upon the earth; and its importance is generally overlooked only because on the surface of the earth it is everywhere pretty uniformly distributed, and therefore gives but little occasion for the production of differences. But in the sea the conditions are quite different. The light as it penetrates into the water is gradually absorbed by the water; it is thus gradually changed, and finally entirely absorbed, so that, at a certain depth, the sea must be perfectly dark. It is to be remarked, however, that the relation of the sun's light to the water of the sea is not perceptibly modified either by the temperature or by any existing variations in the chemical composition of the water, and that therefore this relation must remain pretty nearly the same over the whole earth. If we now place this condition vividly before us, the enormous mass of the sea, above a thin illuminated zone, below a great dark mass, the conviction must, to a certain extent, *à priori*, force itself upon us, *that this fundamental difference in the external conditions of life must find expression in a corresponding difference of the living world.*

If we now consider that, according to the experiments of Secchi, Pourtales, and Bouguer, the inferior limit of light in the sea lies between 43 and 50 fathoms, and that this is exactly the depth that we fixed upon at starting as the boundary-line between the littoral and deep-sea faunas, there can scarcely any longer be a doubt *that the difference which is produced in the fauna of the sea by its conditions of light is no other than that which we distinguish as littoral fauna and deep-sea fauna—*

in other words, ***that the littoral fauna is nothing but the fauna of light, and the deep-sea fauna the fauna of darkness.***

To prove that this is actually the position of matters, several other circumstances may be cited.

Thus it must above all be indicated that the dependence of the organic world upon light not only shows itself at the above fundamental critical point of 50 fathoms, but that it can also be demonstrated at the subordinate degrees of intensity. For example, Lorenz, in his investigations in the Gulf of Quarnero, with his imperfect method of research arrived at the depth of 24–30 fathoms as the lower limit of light. This depth of course cannot be accepted as the actual lower limit; but it certainly forms the limit for a certain intensity; and it is not without interest that we remark that this depth exactly agrees with that which is given as the limit of plant-growth in the sea.

On a former occasion I have called attention to the fact that the depth already mentioned of 43–50 fathoms, found by Secchi, Pourtales, and Bouguer, cannot represent the absolute limit of light, but that small quantities of light no doubt penetrate considerably deeper into the sea, and, indeed, from the analogy of Forel's investigations in the Lake of Geneva, as far as 100–200 fathoms. Now it is certainly very remarkable that Carpenter states the limit to which Nullipores occur at 150 fathoms, and that Agassiz cites precisely the same limit for the greater part of those littoral animals which extend beyond their normal boundary for some distance into the region of the deep-sea fauna *.

With their character of animals of darkness numerous peculiarities in the organization and nature of the deep-sea animals agree. Thus it is known that very many deep-sea animals either have uncommonly large eyes, after the fashion of nocturnal animals, or are completely blind; it is also well known that they are for the most part either pale and colourless or unicolorous, and that varied coloration is exceedingly seldom met with among them; and, finally, it is likewise well known that a very large proportion of deep-sea animals, in many groups, indeed the majority, are vividly luminous.

This last peculiarity is of special importance; for it is clear that luminosity can be of consequence only to such animals as are destined to live in darkness, and, in point of fact, scarcely any luminous animals are known to us from the littoral

* From the investigations of Forel in the Lake of Geneva, of Weismann in the Lake of Constance, &c., it seems to me decidedly to follow that in freshwater lakes also the bathymetrical distribution of animals is determined chiefly by light.

region. Travellers in the tropics represent in lively colours the overpowering impression produced upon the spectator by a living coral-reef with its multifarious and varied fauna. But what an impression would such a reef produce if its inhabitants shone at night in the most different colours! But no traveller has described any such phenomenon. The littoral coral-reefs are perfectly dark at night; but if deep-sea corals are brought to the surface, nearly all of them are seen to glow with the most vivid colours.

Various naturalists have already noticed, and the fact has lately been again brought prominently forward by Moseley, that the pelagic fauna shows a very great resemblance to the deep-sea fauna; for example, the Scopelidæ and Sternoptychidæ are among the most strikingly pelagic animals, but at the same time among the most characteristic of deep-sea animals. It is well known that by far the greater part of the pelagic animals are animals of darkness, dwelling during the day in the obscure depths of the sea, and only coming to the surface at night. But if it be the case that the deep-sea animals are in their nature animals of darkness, the numerous relations manifested between the deep-sea fauna and the pelagic fauna can no longer surprise us in the least; for the pelagic animals are then in their nature fundamentally nothing but deep-sea animals. In connexion with this it must further be indicated that luminosity is just as much diffused among the pelagic animals as among those of the deep sea, and that the above-mentioned pelagic Scopelidæ and Sternoptychidæ especially are as well provided with luminous organs as their relatives in the depths.

By the conception of the deep-sea fauna as a fauna of darkness, moreover, it may be quite easily explained why it appears to be so completely independent of temperature in its occurrence, and at the same time why it commences nearly at the same depth over the whole surface of the earth.

There is, however, a means by which we may test the correctness of the view here put forward in a very simple and exact manner. Thus, if it be true that the animals of the deep sea are nothing but animals of darkness, animals must occur in the caverns and grottoes of the sea which show a certain resemblance to deep-sea animals, or even directly agree with them. No direct investigations in this direction are known to me; but nevertheless there is a series of facts which seem to show that such conditions actually exist. Thus, for example, in the great depths of the Lake of Geneva there is a blind Amphipod, *Niphargus stygius*; but precisely the same animal occurs in springs as well as in the caverns of Carniolia,

and exactly similar species are known from the American caves. Moreover the case is precisely the same with the blind Isopod genus *Cecitodæa*, which occurs both in the great depths of the Lake of Geneva and in the American and Carniolian caves *. Among the most abundant and characteristic of deep-sea fishes are those near allies of the Gadidæ, the Ophidiidæ; and among them several blind species occur. Now it is certainly very remarkable that two blind Ophidiidæ, showing the closest resemblance to their relations of the deep sea, are found in the caves of Cuba.

According to Moseley the corals of the Bermudas show a remarkable sensitiveness to light. The great brain corals (*Diplosia cerebriformis*) grow by preference in the bright sunshine; *Millepora ramosa* and *Symphyllia dipsacea* prefer the shade; and the extremely delicate white *Mycedium fragile* occurs in great abundance in the beach-region, in the interior of cavities. The genus *Mycedium*, which is here found in the beach-region in the interior of cavities, and therefore apparently in darkness, is, however, properly a deep-sea genus, which otherwise occurs only at great depths.

According to Falkenberg, Algæ occur near Naples in a dark grotto at a very small depth, which elsewhere are found only at greater depths at the lower limit of Algæ †.

I have no doubt that these examples will be greatly multiplied if only more attention be paid to these conditions; and I would warmly recommend the study of this question to all naturalists who are in a position to make pertinent observations ‡.

Here, however, I would notice a second question nearly related to the preceding. It is well known that a number of littoral animals penetrate in depth far beyond the limits of the true littoral region, nay, that there are some species (especially of Echinoderms and Vermes) which are found at all depths, from the beach to 2000 fathoms and more. It would certainly be interesting to examine whether these animals of extraordinary bathymetrical distribution are not perhaps nocturnal animals in the littoral region, hiding themselves during the day in dark places, or shutting themselves up in their

* According to Cope and Packard the so-called *Asellus Borelli* of the Lake of Geneva belongs to the genus *Cecidotæa* ("The Fauna of the Nickajack Cave," Amer. Nat. 1882, p. 877).

† See Dodel-Post, 'Illustrirtes Pflanzenleben,' Zurich, 1880 (Marine Algæ).

‡ Fries has already called attention to the resemblance between the deep-sea and cave faunas; see "Die Falkensteiner Höhle, ihre Fauna und Flora" (Württemb. Jahreshefte, xxx. 1874, p. 162).

shells, and going about the business of their lives only at night. Should this be proved, we shall have in strictness to regard such animals not as littoral animals which penetrate to unusual depths, but, from their nature, as deep-sea animals which ascend exceptionally into the lighted regions, but here keep themselves concealed during the day, and display their vital activity only at night.

That the Cephalopoda are chiefly nocturnal animals is well known. The great importance that what has been brought forward in the preceding pages must have for the geologist and the palæontologist especially is at once evident.

On the coast of Brazil, according to Dana, the construction of the coral-reefs is completed in a very peculiar manner. The coral-stocks grow up from a depth of 6–8 fathoms in the form of columns, and then widen out at the top, like an umbrella. In course of time the umbrella-like widened parts of the neighbouring columns unite laterally; and thus there is finally produced an extensive roof of coralline limestone, which rests upon numerous vast columns, and has under it extensive dark catacomb-like spaces. Similar extensive labyrinthically branched systems of caverns are described by Klunzinger also in the coral-reefs of the Red Sea; and, according to Dana, extended branching caves are a perfectly ordinary phenomenon in the coral-reefs of the Pacific Ocean. If, therefore, the preceding hypotheses are correct, a fauna of the character of the deep-sea fauna must occur in these submarine cavities of the coral-reefs; and if we imagine these caverns in course of time filled with the remains of these particular animals, together with material washed into them, and then imagine these coral-reefs subsequently upheaved, a future geologist in investigating such a reef would find nests of deep-sea animals in the midst of the littoral reef-limestone, and be considerably embarrassed thereby.

I may here notice a phenomenon to which Süss has called attention in his well-known work on the Brachiopoda of the Kossen beds. Süss states that the so-called Stahremberg beds, which consist of an accumulation of certain small Brachiopoda, always occur in the form of isolated nests in the Dachstein limestone; and he further adds that these nests are at the same time distinguished by their red colour from the white Dachstein limestone. The white Dachstein limestone with its great Megalodonts, however, is undoubtedly a shallow-water formation, produced after the same fashion as our present coral-reefs, while the fauna of the Stahremberg beds bears the character of a deep-sea formation. If we imagine that the Dachstein limestone was actually a reef, and that this

reef was traversed by cavities, and if we further assume that a Brachiopod fauna of the character of the deep-sea Brachiopoda settled in these cavities, and that finally the cavities were filled up by these shells, together with the washed-in "terra rossa," which, indeed, always occurs upon the free surface of coral-reefs, we have exactly those conditions before us which Süss describes in the case of the Dachstein limestone and the Stahremberg beds.

The interest which the conception of the nature of the deep-sea fauna here advocated possesses for geologists and palæontologists is, however, of a much more general kind. On a previous occasion I have shown that during those epochs through which a warmer climate prevailed at the poles, the temperature-conditions of the sea must have been quite different from those of the present day, and that at that time a higher, perhaps even subtropical, temperature must have prevailed down to the bottom of the sea. If, then, as was previously supposed, the conditions of temperature had been the governing factor in the bathymetrical distribution of organisms, we could not at once apply the observations which we make at the present day upon the distribution of animals in depth in the sea to previous geological epochs, and in general we should lose all reliable foundation for judging of the faunistic conditions of geological epochs. But the circumstances become quite different when we know that the bathymetrical distribution of animals is principally determined not by *temperature*, but by *light*, and especially that the distinction which shows itself between littoral and deep-sea faunas has its ground simply in the fact that the former live in the *light* and the latter in *darkness*; for as the behaviour of the sea-water to light has undoubtedly remained essentially the same through all geological periods, we may also with perfect justice assume that the fundamental features of the bathymetrical distribution of marine organisms have mainly always been the same as now.

As a matter of fact, observation teaches us that the difference between the littoral and deep-sea faunas which we find in existing seas may be traced back in the same way through all formations; and, conversely, this fact may also be made use of in its turn as a further proof of the correctness of the view here advocated.

II.—*Notes on little-known Species of Frogs.* By G. A. Boulenger.

Rana septentrionalis, Baird.

Rana septentrionalis, Baird, Proc Ac. Philad. 1855, p. 51, Boulenger, Cat. Batr. Ecaud. p. 37.
Rana sinuata, Baird, *l. c.*
Rana circulosa, Rice and Davis, in Jordan's Man Vertebr. 2nd edit. p. 355

When I published my 'Catalogue of Batrachia Ecaudata' this frog was known to me only from the rather incomplete description of Prof. Baird. M. F. Lataste has now communicated to me three specimens (one male and two females), which have been sent to him from Canada by Dr. Garnier under the name of *Rana circulosa.* Though the abstract of the description of Messrs. Rice and Davis, given in Prof. Jordan's manual, is far from containing the characters upon which a species should rest, I have little doubt, judging from the coloration, that Dr. Garnier's identification is correct. Neither can there be any doubt as to the correctness of my identification of this frog with *Rana septentrionalis*, the characters assigned to that species and *R. sinuata* (both have been united by Mr. Cope) being applicable to the female specimens before me. I accordingly believe myself justified in regarding *R. circulosa* as a synonym of *R. septentrionalis.*

The following diagnosis is taken from the above-mentioned specimens, one of which has been retained for the national collection:—

Vomerine teeth in two small groups close together, extending a little beyond the hinder edge of the choanæ. Head moderate; snout rounded, with slightly distinct canthus rostralis; interorbital space very narrow; tympanum very distinct, almost as large as the eye in the female, much larger in the male. Fingers rather pointed, first not extending beyond the second; toes not webbed to the tips; subarticular tubercles of fingers and toes rather small; a single small metatarsal tubercle. The hind limb being carried forwards along the body, the tibio-tarsal articulation reaches the posterior border or the centre of the eye. Skin smooth; an extremely indistinct, depressed, glandular, lateral fold, apparently absent in the male. Brownish olive above, spotted or marbled with blackish, or blackish olive with light vermiculation; hinder side of thighs black-and-white marbled; lower surfaces im-

maculate, white, the throat yellowish. Male with two internal vocal sacs. Size of *Rana temporaria*.

This species is intermediate to *Rana Catesbiana* and *R. clamata*.

Rana madagascariensis (A. Dum.).

Limnodytes madagascariensis, A. Dum. Ann. Sc. Nat. (3) xix. p. 155.
Hylarana madagascariensis, Gunth. Cat. Batr. Sal. p. 73.
Rana inguinalis, Gunth. Ann. & Mag. Nat. Hist. 1877, p. 316; Boulenger, Cat. Batr. Ecaud. pp. 67, 462, pl. iii. fig. 3.

Having examined the type specimen of *Limnodytes madagascariensis* in the Paris Museum, I am able to state that *Rana inguinalis* is identical with that species. The specimen referred by me (Cat. Batr. Ecaud. p. 67) with doubt to *R. madagascariensis* is identical with *R. femoralis*, Blgr. (*l. c.* p. 463).

Scaphiophryne marmorata, Blgr.

Scaphiophryne marmorata, Boulenger, Cat. Batr. Ecaud. p. 472.
Scaphiophryne spinosa, Steindachn. Sitzb. Ak. Wien, lxxxv. 1882, p. 189, pl. ii.

This frog was described from a half-grown specimen. The British Museum has now received, through M. V. de Robillard, an adult female, measuring 48 millim. from snout to vent. *S. spinosa* is no doubt identical with this species.

Pseudis mantidactyla (Cope).

Lysapsus mantidactyla, Cope, Proc. Ac. Philad. 1862, p. 352.
Pseudis mantidactyla, Boulenger, Cat. Batr. Ecaud. p. 187.

The British Museum has received a specimen of this species from the Rio Grande do Sul through Dr. v. Ihering. I have also seen several specimens in the Paris Museum, and obtained one for the national collection; these are from Monte Video. I am able to add the following characters to Mr. Cope's diagnosis:—The tips of the fingers are not dilated. The hind limb being carried forwards along the body, the tibio-tarsal articulation reaches the tip of the snout or slightly beyond. This species is very closely allied to *Pseudis minuta*, Gthr., but is to be distinguished by its dilated toes and shorter hind limbs and the much developed external vocal bladders, which are blackish and situated below the mandible, opening by a slit, as in several species of *Rana*. The size is about the same in the two species. The bones are green.

Paludicola gracilis, sp. n.

Gomphobates notatus, Hensel, Arch. f. Nat. 1867, p. 138 (nec Reinh. & Lütk.).

Tongue rather large, elliptical, entire. Vomerine teeth

none. Head small; snout considerably longer than in *P. biligonigera*, at least as long as the diameter of the orbit; nostril nearer the tip of the snout than the eye; interorbital space as broad as the upper eyelid; tympanum hidden. Fingers slender, first not extending beyond second; toes slender, elongate, with a slight rudiment of web; subarticular tubercle well developed; tarsus with a small conical tubercle near the middle of its posterior face; two small prominent oval metatarsal tubercles, smaller than in *P. biligonigera*; a narrow dermal fold connects the tarsal and inner metatarsal tubercles, as in *P. falcipes* *. The hind limb being carried forwards along the body, the tibio-tarsal articulation reaches the eye or a little beyond. Skin smooth, with slightly marked short glandular folds. Brown above, with more or less distinct darker markings on the back; a dark transverse bar between the eyes; a blackish streak from the tip of the snout to the eye; a blackish oblique band, widening gradually, from the eye to the middle of the side; groin generally with a round black light-edged spot, which is entirely concealed when the hind limb is folded against the body; hind limbs with dark cross bars; lower surfaces whitish, more or less mottled with brown. Male with two external vocal sacs. The largest specimen measures 30 millim. from snout to vent.

Numerous specimens, one only being adult, were obtained from Dr. v. Ihering, who collected them in the province of Rio Grande do Sul. Three other specimens (1 ♂, 2 ♀) without locality are in the British Museum.

There can be no doubt that this is the frog referred with hesitation to *Gomphobates notatus*, R. & L., by Dr. Hensel. He describes very accurately the coloration, but does not give the structural characters, remarking, however, that he finds not unimportant differences between his specimens and that figured by the Danish authors. Afterwards † Prof. Peters expresses the opinion that Dr. Hensel's determination is correct, and that the specimens are only a colour variety. The differences, however, are striking, as may be seen by the characters here given. The general proportions are considerably more slender, much like those of *Paludicola Olfersii* (Martens) ‡, from which *P. gracilis* may be easily distinguished by its very distinct tarsal tubercle and tarsal fold.

* The British Museum has obtained several specimens of this frog from Dr. v. Ihering.

† Mon. Berl. Acad. 1872, p. 223.

‡ *Cf.* Peters, Sitzb. Ges. nat. Fr. Berl. 1882, p. 62. This species is known to me from one specimen, which I owe to the kindness of Prof. Peters.

Bufo punctatus, Bd. & Gir.

Bufo punctatus, Baird and Girard, Proc. Ac. Philad. 1852, p. 173, and U.-S. Mex. Bound. Surv. ii. p. 25, pl. xxxix. figs. 5–7.

Of this very remarkable toad I have examined two specimens, from which I draw up the following diagnosis. One was kindly sent to me for examination by M. Lataste, who had received it under the correct name from Dr. Garnier, the same gentleman who sent him the above-mentioned specimens of *Rana septentrionalis*; it came from Texas. The other, from La Paz, California, has been received by the British Museum from the Smithsonian Institution under the name *Bufo Beldingii*, Yarrow (a name which does not appear to have been published). The descriptions of Baird and Girard, though incomplete, are sufficient to leave me no doubt as to the correctness of my identification. Dr. Yarrow, in Wheeler's 'Report,' Zool. p. 523, observes that "the figure of this species in the 'United-States and Mexican Boundary Survey,' unlike that of the other toads, is very defective, not representing the most marked characters well, and adding two pairs of dorsal glands which do not exist."

Head triangular, with very low bony ridges, viz. a canthal, a preorbital, a supraorbital, and a postorbital, the latter forming a right angle; derm of upper surface of head more or less involved in cranial ossification; snout short, prominent; interorbital space concave, broader than the upper eyelid, equalling the diameter of the orbit; tympanum round, perfectly distinct, half the diameter of the eye. First finger a little longer than second; toes one-third webbed; subarticular tubercles simple; two moderate metatarsal tubercles; a slight tarsal fold. The hind limb being carried forwards along the body, the tarsometatarsal articulation reaches the eye. Upper surfaces with small round tubercles; paratoids small, prominent, roundish or subtriangular. The specimen communicated to me by M. Lataste is uniform greyish olive; that obtained from the Smithsonian Institution is yellowish olive above, the sides and limbs blotched with blackish, the tubercles being slightly reddish; lower surfaces dirty white, immaculate. Both specimens examined are females. From snout to vent 57 millim.

The place of this species in the system seems to be near *Bufo granulosus*.

III.—*Further Observations on the so-called "Farringdon Sponges"* (Calcispongiæ, *Zittel*), *followed by a Description of an Existing Species of a like kind.* By H. J. Carter, F.R.S. &c.

[Plate I.]

Through the great kindness of Dr. G. J. Hinde, F.G.S., I have not only received a copy of his "Notes on Fossil Calcispongiæ" (*, No. 14), but have been permitted to examine

* Publications to which reference is made in the following communication:—

1.—1864. Monograph on the British Spongiadæ. By J. S. Bowerbank. Vol. ii., with 37 plates, vol. iii. 1874, and vol. iv. 1883.

2.—1872. Die Kalkschwamme. Von Ernst Hackel. 3 vols., including Atlas.

3.—1874. "Development of the Marine Sponges from the earliest recognizable appearance of the Ovum to the perfected Individual." By H. J. Carter. Ann. & Mag. Nat. Hist. vol. xiv. p. 321, with 3 plates.

4.—1876. Mémoire sur l'Embryologie de quelques Éponges de la Manche (Thèse). Par Ch. Barrois. With 16 plates.

5.—1877. "On a Holorhaphidote Sponge from the Cambridge 'Coprolite' Bed." By W. J. Sollas. Quart. Journ. Geol. Soc. for May, vol. xxxiii. p. 242. With 1 plate.

6.—1878. "Mr. James Thomson's Fossil Sponges from the Carboniferous System of the South-west of Scotland." By H. J. Carter. Ann. & Mag. Nat. Hist. vol. i. p. 134. With 2 plates.

7.—1878. Petrefactenkunde Deutschlands (Schwämme). Mit einem Atlas von 28 Tafeln in-folio mit c. 1000 Abbildungen. Von F. A. Quenstedt.

8.—1878. "Studien über fossile Spongien: Monactinellidæ, Tetractinellidæ, und Calcispongiæ." Von K. A. Zittel. With 1 plate. Translated by W. S. Dallas, F.L.S. Ann. & Mag. Nat. Hist. vols. iii. and iv. pp. 304 and 364, and 61 and 120 respectively.

9.—1878. "On the Structure and Affinities of the Genus *Catagma*." By W. J. Sollas. Ibid. vol. ii. p. 353. With 1 plate.

10.—1879. "On *Holasterella*, a Fossil Sponge of the Carboniferous Era, and on *Hemiasterella*, a new Genus of Recent Sponges." By H. J. Carter. Ibid. vol. iii. p. 141. With 1 plate.

11.—1879. "Note on the so-called 'Farringdon (Coral-Rag) Sponges' (Calcispongiæ, Zittel)." By H. J. Carter. Ibid. vol. iv. p. 431.

12.—1880. "On Fossil Spicules from the Carboniferous Strata of 'Ben Bulben,' near Sligo." By H. J. Carter. Ibid. vol. vi. p. 209. With half a plate.

13.—1882. "Pharetronen Studien." Von Dr. Gustav Steinmann. Neues Jahrbuch f. Mineralogie, Geologie, und Palæontologie, 11. Band, p. 139. Mit 4 Tafeln (Separat-Abdruck thankfully received, on the 26th August, 1882.)

14.—1882. "Notes on Fossil Calcispongiæ, with Descriptions of new Species." By Dr. G. J. Hinde. Ann. & Mag. Nat. Hist. vol. x. p. 185. With 3 plates.

the specimens and preparations from which they were compiled, whereby I have been able to confirm all that he has stated respecting them. Not only this, but in a slice of a specimen of *Verticillites* (Dcfr.) *anastomans*, Mant., from Farringdon, in my own cabinet, I see similar spicular structure to that which Dr. Hinde has represented in his *V. D'Orbignyi*; as also in one from a specimen of *Sestrostomella* (Jura), which Prof. Zittel kindly sent me, in which the pitchfork-like (two-pronged) spicules of Dr. Hinde's two *Sestrostomellæ* are also present, and have been identified, as he has identified them before, with the representations of the existing calcispicules to which the late Dr. Bowerbank gave the name of "inequi-furcato-triradiate" (No. 1, vol. i. p. 268, pl. x. fig. 237), subsequently found by Häckel in Calcisponges from the coast of South Australia and the Indian Ocean (No. 2, Atlas, Taf. xxiii. fig. *h*, and vol. ii. pp. 127 and 166). Hence there can no longer be any doubt, with this additional knowledge, that there are, in Prof. Zittel's order of fossil Calcispongiæ, at least some genera whose fibre bears spicular forms which are identifiable with those of existing Calcispongiæ. Further than this, in the prepared slice of *Peronella multidigitata*, Mich., kindly sent me for conviction by Prof. Zittel, not only are the triradiates identical, as I have before stated, but their peculiar arrangement I now see, in one part at least, is equally identical, with that of existing Calcispongiæ.

Still, although the spiculation in many instances, especially in that problematical form *Verticillites*, may so far aid us in identifying these fossils with the Calcisponges of the present day, there are others in which it appears to be of so little service in this respect that, if these are also to be regarded as Calcisponges, they must also be considered extinct, so far as our knowledge of existing forms go; for there is no Calcisponge of the present day with which such spiculation can be directly identified.

Thus in *Manon macropora*, Sharpe, = *Elasmostoma*, From. (No. 8, vol. iv. p. 130), Prof. Sollas, who has examined its fibre microscopically in the usual way (that is, by extremely thin slices mounted in Canada balsam and viewed by transmitted light through the microscope), has noticed and delineated slender thread-like forms, triradiates, quadriradiates, and even quinqueradiates, together with bifurcated arms and truncated shafts or branches (No. 9, vol. iii. p. 354, pl. xiv. figs. 2, 5, 14, 7, 11, 12, and 19 respectively), the slender thread-like forms, or "filiform spicules," as they are afterwards termed, chiefly occupying the outer part of the fibre, and the "multiradiates" the axis; also that while "in some

instances the rays are scarcely of larger diameter than the filiform spicules, in others they are several times as large, and appear giants by comparison" (No. 9, p. 355).

Now, as these are forms which I have more or less witnessed myself under similar examination, and we are only on the threshold of our knowledge respecting them, partly from the want of observers, but principally perhaps from the difficulty of the subject, it may not be unacceptable to state what I myself have seen.

Thus the "filiform spicules" which I find very numerous in the fibre of my specimens of ? *Manon peziza* (No. 7, Taf. cxxxii. fig. 30) and ? *Scyphia perplexa* (No. 7, Taf. cxxv. fig. 63), wherein, on account of their regular parallel outlines and flexuous course, they look very much like the filaments of Confervæ, are for the most part truncated by the thinness of the slice, and thus present themselves in a fragmentary state, in which it is difficult to find one with a natural termination. Where the section has caused them to be truncated horizontally (that is, where the fibre has been cut directly across and they appear under the microscope as if ascending from below), their ends are seen to be circular and to present a punctum in the middle, indicative of an axial canal. They occupy the outer part of the fibre, and thus frequently become entwined round the axis of a colossal shaft ("giant by comparison," as Prof. Sollas expresses it), which we shall find by-and-by to be a characteristic feature of the spiculation in some of these sponges; or the axis may present a comminuted appearance, in which they often appear to have their origin, which "comminuted appearance," partly obscured in flocculent matter, appears to be the remains of a half-dissolved chain of triradiates, rendered still more indistinct perhaps by being on their edges and having their arms cut off both above and below by the section. But be this as it may, to obtain the entire forms of the spicules in this fibre by such thin slices can only be the result of accident extended over long periods of examination, being almost as difficult as discovering the form of a knot of twine by a thin slice through its centre.

As the filiform spicules pursue their course along the reticulated fibre, they not only cross each other obliquely, so as to sheathe as it were the axis, but partly surround the fenestral openings in the fibre itself in such a manner as to give an appearance of great original flexibility, while together they must thus have formed a densely filiferous cord by intertwining with each other, and this, through anastomosis, must also of itself have produced a reticulated self-supporting structure without the calcitic incrustations which now invest it.

In diameter the filiform spicules somewhat vary above and below the four-thousandth part of an inch, which is much beyond that of the arms of many triradiates in existing Calcisponges; but, from their long and flexuous course, subjecting them to truncation in a thin slice I have only been able to find one or two instances of an attenuated natural termination, and that, too, only at one end of the fragment. Instances are not uncommon where they may be inferred to terminate in this way in one direction, viz. in a point; but this may be so simulated by oblique-sectioning or descending out of focus, that it would be hazardous to go beyond an opinion in the matter. On the other hand, there is also often evidence of simple or multiple division, as in *Peronella dumosa*, from Farringdon ('Handbuch der Palæontologie,' Zittel, p. 190, fig. 108), wherein the filament may be observed to divide into two or more arms radiating from the same point, one or more of which may be elongated beyond tracing (*i. e.* filiform), or one or more short and pointed, mixed with regular or equiarmed triradiates that are free; but it is often impossible to substantiate this, from the presence of the flocculent material produced by the fossilization giving rise to a cloudiness in the fibre, which obscures the very part which it seems desirable to be able to follow with certainty; in short, it is only by the happy coincidence of a sharply defined object occurring in a clear place that such a point can be satisfactorily determined.

Difficult, however, as it is to follow the "filiform" spicules to their extremities in the fossils above mentioned, chiefly from their great length and undulating course, a key to their interpretation seems to be afforded by the fibre of Prof. Zittel's preparation of *Peronella multidigitata* (to which I have alluded), wherein, being of the same kind but shorter, they can be clearly seen to be the arms of a triradiate. Perhaps this slice may have been taken from an unusually favourable specimen for the purpose; but be that as it may, not only *this* identity, but an identity in form and arrangement between the triradiates themselves and those of existing Calcisponges can be witnessed, as I have before mentioned. It is true that in many instances the third ray is more or less reduced by arrest of development to a mere tubercle, as pointed out by Dr. Hinde in his *Verticillites D'Orbignyi* (No. 14, p. 193, pl. xi. figs. 15–22, &c.); yet in many cases all three rays are perfect and unmistakable in their form and arrangement.

As regards the "colossal" spicules (a term borrowed from Häckel in existing species) of the axis, so well shown in Dr. Hinde's illustration of the fibre of his *Sestrostomella rugosa* (No. 14, pl. xii. fig. 1, *a*), all that I need say after an exami-

nation of his preparations is that, here and there, these spicules present a short, thick, conical process or spur, which seems to be the equivalent of a *ray*, and that, if the whole of the spicule could be seen at once, it is not improbable that it would be found to be a colossal tri- or quadriradiate, whose arms are diverted from their usual arrangement when free to that which is required of them when forming the axis of reticulated fibre; for certain it is that the presence of calcisponge triradiates and the "pitchfork-like spicules" with these colossal spicules do so far identify them with existing species that, as Dr. Hinde has shown in this remarkable discovery (No. 14, pl. xii.), there can be no doubt as to their original nature, however different the colossal spicule may render the *Sestrostomellæ* from any thing that has hitherto been shown to exist in the Calcispongiæ of the present day. Still I think that I shall be able to show hereafter, by the description of a new species of Calcisponge from the south-west coast of Australia, that the principle of this spiculation still exists, if not traceable, already in Häckel's "colossal" spicules. To the crenulated structure which immediately surrounds the colossal shaft in *Sestrostomella* (No. 14, pl. xii. figs. 1 and 2) I shall return presently.

Meanwhile I would call the reader's attention to a little cylindrical fossil from Farringdon, which in my "Note" on these sponges (No. 11, p. 434) I briefly described under the idea that it was a "calcified Lithistid," but which, it will soon be seen, turns out to be a species of *Scyphia* (Pl. I. figs. 1–3)—? *S. cylindrica*, var. *baculata*, Quenstedt (No. 7, Taf. cxxiii. fig. 11), allied to *Sestrostomella* inasmuch as its fibre is provided with a colossal axial spicule bearing here and there a short conical process or spur in concentrically laminated fibre (fig. 9, *a*, *b*, &c.). Unfortunately, however, the fibre here is not in such a good state of preservation as that of Dr. Hinde's *Sestrostomella rugosa*; but sufficient remains to show that it presents a Lithistid aspect (fig. 4), although the many-armed spicules of which it is composed were not naked as in a Lithistid, but surrounded by the concentrically laminated fibre to which I have just alluded, like the siliceous envelope which similarly forms the fibre of a Hexactinellid (fig. 6, *a*, *b*, &c.),—moreover that the colossal axial spicules often present here and there, and apparently without any regularity in size or distance, a short conical arm or spur like those of *Sestrostomella* (figs. 5, 7, 9, &c.), that the outlines of their surface as seen in the section may be even or crooked or crenulated (figs. 7–12, &c.), and that the spur itself is sometimes sparsely covered with short vertical spines (fig. 5)—also that the sheath or concentrically laminated fibre enclosing these colossal spicules may

be composed of a variable number of layers to which the same observations apply, with the exception that the outlines in the section show that they were much more irregular in form (figs. 6–12) and themselves here and there threw out a spur (fig. 8, *b*), while in some instances the surface of the outer layer was evidently tubercled (fig. 6, *b*). Hence the fibre might be tuberculated as well as spurred here and there. Also in one part of the slice there are two long straight rays like those of an existing calcispicule, which, but for their point of union and divergence being close to the edge, and therefore broken away, would probably have been accompanied by a third if not a fourth arm (fig. 11); and these evidently form the axis of the sheath, which on one arm is continuous with that of the neighbouring mesh (fig. 11, *c*); so that we may fairly infer that the colossal spicule of the axis of the fibre throughout was a tri- or quadriradiate, although contorted (we might almost say distorted) and modified in the form of its arms to meet that of the meshwork.

Although the crenulated structure immediately surrounding the colossal spicule in *Sestrostomella rugosa*, to which I have above alluded, is not so striking in *Scyphia cylindrica*, still it has occurred to me, from observing an intermediate condition in my specimen of *Sestrostomella* from the Jura, that it might in like manner be the result of a section of the crenulated laminæ of the sheath, which, to a certain extent, might also have been influenced by the form of the original spicule in the first place; still I observe in some fossil spicules of a Lithistid from the Upper Greensand that have been mounted in Canada balsam the *straight* lines of a shaft *internally*, while the *outside* is tuberculated, illustrating what I have long since stated, viz. that the ornamentations of a spicule are put on last upon an originally plain shaft—that is, simply that the spicule begins in this form and may end in a complicated one. In some parts, where the fibre is in good preservation and therefore solid, a transverse section shows that the axial spicule was composed also of concentric layers (fig. 10, *a*), which often seem to merge into the subsequent layers of the sheath. The latter, however, must not be considered homologous with the sheath in *Verticillites* &c., where it is simply a fossil adjunct, while in the genus *Sestrostomella* &c. it appears to have been part of the original structure, however much it may have become altered by subsequent fossilization.

In no instance have I been able to see, in *Scyphia cylindrica*, the free triradiates and "pitchfork-like spicules" present *in* the fibre of *Sestrostomella*.

Thus we have an extinct structure which, curiously enough,

is a mixture between that of a Lithistid and a Hexactinellid in a calcareous sponge! Nor is the structure more like that of a Lithistid (fig. 4) than the general form of this little fossil (figs. 1–3), which, being subcylindrical, furrowed or not as the case may be at the aperture (fig. 2), and pierced to the bottom by a continuous cloacal canal, into which the larger branches of the excretory system entered laterally (fig. 3), adds to the delusion.

If it be identical with Quenstedt's *Scyphia cylindrica*, var. *baculata*, to which Zittel has given the generic name of "*Peronella*" (No. 8, vol. iv. p. 69), then *S. cylindrica* and *P. cylindrica* are totally different in their spiculation, as Zittel's slide, to which I have alluded, and his representations of the latter, compared with what I have stated of the former, point out—a fact which shows that resemblance in general form alone is no more to be trusted in fossil than in existing sponges, and thus the necessity of studying *each form* through translucent slices under the microscope to obtain the spiculation, which I fear must be long before it is generally accomplished, since it not only involves the necessity of procuring a favourable specimen, but time and ability, on the part of the operator, if not the employment of a lapidary. What spongologist without this would have said that the little fossil form called "*Verticillites*" had been a Calcisponge, which Dr. Steinmann has virtually *denied*, evidently for want of a favourable specimen in which to see the triradiates (No. 13, p. 165).

I have given several illustrations from the fibre of *Scyphia cylindrica*, var. *baculata*, which for the most part have been drawn under a power of about 300 diameters, with copious measurements, so that they may be almost viewed as facsimiles.

With reference to the "multifid" spicules figured by Prof. Sollas from the fibre of *Manon macropora*, &c. (*op. et loc. cit.*) and those by Dr. Steinmann from his *Cryptocœlia Zitteli* (No. 13, p. 177, pl. viii. fig. 5), I can only state that the same kind of *facies* is presented by slices of the fibre of my specimen of *Spongites* from Farringdon (? *Spongites sella*, No. 7, Taf. cxxvi. figs. 58, 59), wherein, however, it is evident that the spiculation is chiefly composed of the common equiarmed triradiate of different sizes, accompanied by modified forms in which the arms appear to be much extended, if not branched also; while one spicule much larger than the rest often presents itself under the form of a simple straight shaft in the axis of the fibre, like that of *Sestrostomella*, although not nearly so colossal, being similarly inflated at the extremities, at one of which it may present a short spur, while in other respects they appear to be connected with other shafts of a

modified tri- or quadriradiate which extended into the adjoining portions of fibre, but have been cut away by the sectioning. Still the structure is very badly preserved; but whatever the spiculation may hereafter in a more favourable specimen prove to be, I can only regard it, from the presence of the triradiates &c., as allied in spiculation to the foregoing species, and therefore in no way connected with the Echinonemata, as suggested by Prof. Sollas (No. 9, p. 359), or with the Alcyonidæ, as proposed by Dr. Steinmann (No. 13, p. 177). Indeed the indistinctness arising from a partial dissolution of the spicules, rendered, as before stated, still more deceptive by the thinness of the section, led me to characterize it formerly as "?Lithistid-branched" in my "Note on the Farringdon Sponges" (No. 11, p. 433), which, now that I am better informed in all respects regarding these fossils, must be repudiated in favour of Prof. Zittel's original and sounder views.

The result of a similar examination of *Oculospongia dilatata* from Farringdon (another of Zittel's genera) shows that its fibre also is composed of a chain of triradiates, but apparently without any large axial spicule, while that of *Peronella cylindrica* in Prof. Zittel's slide evidently possesses one; and the echination produced by the triradiates outside, so faithfully represented in his published illustration (Handbuch der Palæontologie, p. 190, fig. 107), will be easily distinguished from that of a siliceous Echinonematous sponge, when the new species of Calcisponge from South-west Australia, to which I have alluded, comes to be described, in which the peculiarly formed colossal spicules of the fibre *internally* are bound down by a number of smaller equiarmed triradiates whose arms project *externally*.

While, however, there are spiculations among Zittel's fossil Calcisponges which indicate a more remote alliance with existing Calcisponges than others, there are some which have not the least resemblance to them in this respect; and hence, if we are to maintain the latter among the former, it must be by some other evidence than that of the presence of tri- or quadriradiates. I allude to the genera *Stellispongia* and *Pharetrospongia*, in both of which the fibre is entirely made up of acerate or monactinellid spicules "dove-tailed" in between each other so as to form an anastomosing, cord-like, reticulated structure. In the former the spicule *appears* (for the minute structure of the specimen is clouded, and therefore not well defined) to have been undulating, and in the latter (where it is clear) to have been slightly curved; but both were smooth, fusiform, and pointed at each end, although the general aspect

of the former (that is, in *Stellispongia*) is short, cylindrical, and obtuse; but this seems to arise from the pointed ends in most instances being hidden beneath the undulations. In *Stellispongia variabilis*, from the Upper Keuper of St. Cassian in the Tyrol, the spicules appear to have consisted of about two bends, and to have been about 18 by 2-6000ths, and in *Pharetrospongia Strahani*, from the Greensand of Folkstone, where the spicule is simply curved, about 66 by 2½-6000ths inch in their greatest dimensions respectively. I am indebted to Dr. Steinmann, of Strassburg, who has published a good photograph of it (No. 13, Taf. ix. fig. 2), for the preparation of the former, and to Prof. Sollas for an entire specimen of the latter, which is thoroughly described and illustrated in the 'Quarterly Journal of the Geological Society' (No. 5, p. 242 &c., pl. xi.), both of which I have had by me for some years past.

Having stated above that neither the spicular form in *Stellispongia* nor that in *Pharetrospongia* bears the "least resemblance" to that of existing Calcisponges, I of course mean in the absence of tri- and quadriradiates; but, to prevent cavilling, I would add that in only one or two instances among existing Calcispongiæ is there a distinct resemblance to the monactinellid spicule of *Pharetrospongia Strahani*, and in these they are subsidiary—that is, in great minority. Thus they are scattered horizontally over the surface and throughout the body, otherwise made up of radiate spicules, of the British species called by Dr. Bowerbank "*Leucogypsia Gossei*" (No. 1, vol. i. pl. xxvi. figs. 349, 350) = *Leucandra Gossei*, Häckel (No. 2, Atlas, Taf. xxxii. fig. 2, *f*), also in Häckel's *Leucandra bomba* (No. 2, Taf. xxxviii. fig. 4); while a slight resemblance to the undulating form of *Stellispongia variabilis* may be seen in his *Ascandra reticulum* (No. 2, Taf. xiv. fig. 4, *f*), and *Leucortis pulvinar*, var. *indica* (No. 2, Taf. xxix. figs. 16–18), respectively.

On the other hand, precisely the same form of monactinellid spicule as that in *Pharetrospongia Strahani*, and no other, may be seen to form precisely the same kind of fibre in *existing* species of Renieræ, as Prof. Sollas has shown in his faithful account of this sponge (No. 5, pl. xi. fig. 12), where, of course, the mineral composition is siliceous. There is no sheath here as in *Sestrostomella* and *Scyphia cylindrica*, no colossal axial spicules, triradiates, or "pitchfork-like spicules," but one single form of monactinellid spicules, which, "dove-tailed" into each other with great plurality, form a round spiculo-fibre similar to that of similar spicules in a vast number of siliceous sponges of the present day. If, then, these sponges are to be considered fossil Calcispongiæ, some other means

must be found of proving this than the absence of the radiates &c.; at the same time it must be evident to all, that if we admit the *radiates* to be an indication of Calcisponge nature, the same argument holds good as to the form of the *monactinellid* above described being *by itself* an indication of a siliceous one.

I do not think that we can place much confidence in the ontogenetic argument; for although Dr. Charles Barrois, in his Inaugural Thesis (No. 4, p. 27), asserts, upon the authority of Metschnikoff and F. E. Schulze, together with his own observations, that in the development of the sponge-ovule the monactinellid spicules appear *first*, and views my observations, which are *opposed* to it, as of no "great importance," because they were made in a single instance (No. 3, pp. 392, 393, pl. xx. fig. 16), it is just possible that, if I had considered it necessary to go further, I might, with the material at my command, have found fifty; while, in the figure of the *still swimming* and *unfixed* state of the embryo of an *Esperia* represented in the following plate (fig. 25), I have shown that the *whole* complement of the spiculation of the species, viz. one skeleton- and three forms of flesh-spicules, may already be seen, as perfect in their forms, although in miniature, as in the fully developed sponge—neither one nor the other, so far, appearing first. Thus I do not think the priority of existence of *Pharetrospongia* among the Calcisponges can claim any support from our present knowledge of the development of the sponge-ovule.

Prof. Zittel lays much stress on the disappearance of "every trace of minute structure" in several of his Calcispongiæ when followed by their conversion into silica, as being indicative of an originally calcareous nature (No. 8, vol. iii. p. 368), which seems to accord generally with what I will now mention, viz.:—A short time ago I received two fragments of flint, each from 2 to 3 inches in their longest diameter, one of a black colour coming *directly from* the "chalk," and the other brown, from the stony detritus of once overlying "greensand and chalk" in this locality (Budleigh-Salterton, S. Devon), in which the remains of all kinds of sponges are innumerable, although of course much worn. In both fragments there is a fossilized portion of a branched sponge whose digitations were about 5-12ths inch in diameter. This in the black flint appears under the form of a white anastomosing reticulated fibre, that can be seen *in* the latter through its transparency; but there happens to be a portion of it *outside* the flint which never could have been in it, and which must have been directly in the chalk; and this fibre,

averaging 1-60th inch in diameter, is composed of opaque, waxy-looking, yellowish calcite, axiated by a core not more than half its size of monactinellid spicules. (How comes this calcitic investment?) In form the spicule is slightly curved, fusiform, smooth, and pointed at each end, apparently about 15 by 1-1800th inch in its greatest dimensions, and the *whole* soluble in nitric acid. The same appears to be the case with the reticulated fibre *inside* the flint; but when a fragment of this has been subjected to the influence of nitric acid and examined under the microscope, a small portion of the *spicular core in which the spicules are evident* is seen to remain, showing that *in* the flint it is partially silicified.

On the other hand, in the "brown flint" from the detritus of the greensand &c. a mould only of the fibre generally exists; but here and there *fragments* of thin siliceous fibre bearing the same form of spicule, only a little smaller than that in the black flint. partially occupies the cavity which, had there been any calcite present as in the chalk-flint, might have been entirely filled. Thus, although not wholly, Prof. Zittel's statement seems to be generally demonstrated. The successively inflated form of the branch in this fragment and its round extremity, together with the form of the spicules, is so like an existing species of *Chalina*, that it is almost impossible to view it otherwise than as a fossilized specimen of that kind of sponge.

It is in the wax-like, yellowish calcitic mineralization similar to what has been described in the reticulated fibrous structure *outside* the "black" flint that the fibre of *Pharetrospongia Strahani* presents itself in the pure chalk, as shown me in several instances by Dr. Hinde in the geological collection of fossil sponges at the British Museum, where also there is a specimen, almost identical with that which I have described in the "black flint," that also effervesces with acid, as also shown to me by Dr. Hinde—all seeming to demonstrate that these specimens have been calcareous from their *origin*. But have they been so? for this is the "vexata quæstio."

Let us turn our attention to what has taken place in this respect during the fossilization of the Hexactinellid called *Acanthospongia Smithii*, and the Holorhaphidote sponge *Pulvillus Thomsoni* respectively, both from the "mountain-limestone" of the Carboniferous series in the neighbourhood of Glasgow (No. 6, vol. i. p. 128, pls. ix., x.). It may fairly be inferred from the intimate resemblance in form of the spicules of these two species with those of the present day, together with their minute structure (which has been faithfully preserved in the limestone), that they were originally

siliceous; it may be easily seen that as they lie in the grey compact limestone (now before me) they present themselves under a smooth form, which, on being carefully extricated and placed in nitric acid, dissolves away *completely* with strong effervescence; and on boiling a portion of this limestone so charged, it is found that many of these spicules come out in the form of a ragged cylinder of silex, which, in the rotten or decomposed parts of this limestone, present themselves in the state of *chalcedony* fretted out by rhomboidal cavities (No. 6, pl. ix. fig. 14, *a*, *b*, *c*).

Now the "mountain (Carboniferous) limestone" is analogous in this series to the "chalk" in the Cretaceous System; and if the double change in mineral composition has taken place in the former, why may it not have done so in the latter, in some although not in all instances? Thus, why might not *Pharetrospongia Strahani* have been siliceous in the first instance, just as much as *Acanthospongia Smithii* and *Pulvillus Thomsoni*?

It is not my business here to deal with the processes of transitionary mineralization and their why and wherefore (I know nothing about them comparatively, any more than of mineral metamorphism in general, or the elevation and depression of whole continents), but to deal with facts; while Zittel himself cautions us, in these instances, against the employment of arguments based on chemical reasoning (No. 8, vol. iii. p. 366).

Having got so far as, in my opinion, to throw some doubt over the original nature of *Pharetrospongia Strahani* and the like being calcareous, we have now to ask ourselves, what evidence there is of the existence of any fossil sponges, like those of the Monactinellid series of existing ones now in the Zoological Department of the British Museum, which of themselves as much outnumber the existing Hexactinellida and Lithistida there as the latter do the former in the fossil collection of the Geological Department—indeed more so; for I do not know of a single instance where an undisputed example is to be found in the latter—considering *Pharetrospongia Strahani* and the like spiculations calcareous.

If we consult some of the highest authorities on the *entire* forms, we find, as in Quenstedt's 'Petrefactenkunde' (No. 7), nothing in this way but Hexactinellida, Lithistida, and the so-called Calcispongiæ. If on their *minute structure*, we find in Zittel's elaborate and invaluable investigations nothing beyond a comparatively insignificant mention of the Monactinellidæ, under his genera *Opetionella* and *Scoliorhaphis*, together with *Cliona*, which, being an excavating sponge, is recog-

nized by the casts of its borings alone (No. 8, vol. iii. pp. 305, 306); while his Tetractinellidæ, which do not concern us so much here, hardly fare a bit better. Again, in the British-Museum collection the same thing is repeated. Nothing meets one's eye to correspond with the great number of existing Monactinellid sponges in the Zoological Department.

If we are not to infer the original nature of fossil sponges from the resemblance of their spicules to those of existing ones (that is, the presence of the peculiarly formed tri- and quadriradiates to indicate a calcareous, and that of a monactinellid spicule, such as in *Pharetrospongia Strahani*, to betoken a siliceous spicule, like that of a Renierid among my Holorhaphidota), we must fall back upon the mineral composition; and we have seen how misleading this may be. It is true that a calcareous spicule may remain calcareous under the influence of a calcareous lye; but this may not be the case with a siliceous one. Witness the calcareous condition of the Hexactinellid *Acanthospongia Smithii*, and, still more to the point, the "pinlike spicule" in Mr. Holl's specimen of *Verticillites* (see "P.S."). Again, if we confine all the fossil sponges to the Hexactinellida, Lithistida, and Calcarea, together with a few Pachytragid and Pachastrellid species, what become of the fossil representatives of the great body of existing monactinellid sponges to which I have alluded? Are we prepared to even conjecture that they are all recent introductions, when we find some of their spicular forms already so far back as the Carboniferous period (No. 6, vol. i. pl. ix. fig. 19, pl. x. fig. 5; and No. 10, vol. iii. pl. xxi. fig. 11, also in No. 12, vol. vi. pl. xiv. fig. 14) at least?

I think not, and therefore, for the present, prefer considering such fossil sponges as *Pharetrospongia Strahani*, although at present calcareous, to have originally been siliceous and allied to the existing Monactinellida, to which I have alluded, rather than to the Calcispongiæ, among which Zittel has placed them.

Returning to the latter for a moment, I cannot help observing that the important confirmation supplied by Dr. Hinde respecting the kind of spicules of which that unique little form *Verticillites* was composed, cannot be overrated; nor can his discovery of the peculiar kind of spiculation in *Sestrostomella*, together with the presence of the pitchfork-like spicules (two-pronged) identified with those of existing species, as before mentioned, be considered otherwise than as opening up an entirely new although fossil character, which must become most useful in classification.

To the sheathed form of this spiculation I have already

alluded; and the colossal size of the axial spicule has been most faithfully described and portrayed by Dr. Hinde (*l. c.* No. 14),—all of which led me to ask myself if I could not find some lingering existence of it in existing species, when I remembered that I had by me a little Australian Calcisponge that had, from its peculiar spiculation, been put by for opportune description. On turning to it I observed that its spiculation, although not identical with that of *Sestrostomella*, nevertheless presented the same principle; that is, it consisted of comparatively colossal triradiates of a peculiar form, covered in by much smaller equiarmed ones of the staple kind. This species, as it is new, I will describe under the name of

Leucetta clathrata, n. gen. et sp. (Pl. I. figs. 13–17.)

Small, flat, sessile, cake-like in form, more or less subcircular, slightly convex (Pl. I. fig. 13, *a*). Texture firm. Colour now light yellowish white. Consisting of a fibro-clathrous spicular structure which, spreading upwards from a continuous layer adherent to the frond of the foliaceous coralline (*Udotea*, sp.) on which it has grown, terminates above in a free surface that presents a solid vermiculo-reticulation in prominent relief (fig. 14), of which the interstices communicate with the clathrous structure throughout, while the summit is devoted to the osculum (fig. 14, *a*), which is but an enlarged interstice of the vermiculo-reticulated surface, the rest in the fresh state probably having been covered by a thin layer of dermal sarcode in which the pores or *in*halant orifices were situated. Spicules all triradiate, but of two distinct forms, viz.:—one of great size comparatively, consisting of three stout arms of equal length and thickness, bent downwards from a dome-like summit and everted at the extremities so as to form a kind of tripod, averaging in its largest size about 31-6000ths inch high and 38-6000ths inch at the base, with a thickness of 9-6000ths inch in the largest part of the arms (fig. 16); the other much smaller, consisting of an equiarmed equiangled triradiate, averaging in its largest size about 18-6000ths by 2½-6000ths inch in the greatest dimensions of its arms (fig. 17). The former, few in number comparatively, are confined to the free surface, where their summits alone are chiefly visible (fig. 15, *a a*) along the lines of the vermiculo-reticulation, while their arms, being directed inwards, are concealed by the smaller triradiates which in infinitely greater numbers form the rest of the structure, and thus echinate the surface with their projecting rays (fig. 15, *c c*). Size of largest specimen about 2-12ths inch in diameter by 1-48th inch in thickness.

Hab. Growing plentifully on the fronds of a foliaceous coralline (*Udotea*, sp.).

Loc. S.W. coast of Australia.

Obs. This little specimen, which I am pretty sure was sent from Freemantle to the late Dr. Bowerbank by Mr. G. Clifton, is contained in a small flat pill-box bearing no other label than a note of interrogation. It will therefore hereafter be found among the existing Calcisponges in the British Museum, to which collection I have already added several specimens. The peculiar form of the large triradiate is characteristic of the species; and the solidity of the vermiculo-reticulation, which is *not hollow* like that of the contorted tube of *Clathrina*, Gray, = *Grantia clathrus*, Schmidt, although very much like it in external appearance, characterizes the genus; while the latter resembles the appearance of Zittel's fossil Calcispongiæ generally, and the former the *spiculation* of his genus *Sestrostomella*. Following Häckel's arrangement of the Calcispongiæ (No. 2, zweiter Band, p. vi) it belongs to his second family, viz. Leucones, and is thus closely allied to his genus *Leucetta*, in which the spicules are all triradiate; but as he mentions no instance of a "*solid* vermiculo-reticulation" we must view this species as the type of a new genus, and hence I have called it *Leucetta clathrata*, where, curiously enough, it will be located close to his *Leucetta pandora* and *Leucandra pulvinar* (No. 2, zweiter Band, pp. 127 and 166 respectively), both of which come from the west and south coasts of Australia, and possess, as before mentioned, the same kind of pitchfork-like spicules discovered in *Sestrostomella* from the Cretaceous at Vaches Noires, near Havre, by Dr. Hinde, and confirmed by myself in the specimen from the Jura, kindly sent me some time since by Prof. Zittel. The specimens of *Leucetta clathrata* which I have, although numerous, are all small; but there is no reason why much larger ones may not exist, if not be found hereafter.

Protosycon, Zittel.

Although there can be little doubt from Quenstedt's representations (No. 7, Taf. 131. figs. 24–27) and the preparation which Prof. Zittel kindly sent me, that his *Protosycon punctata* was one of Häckel's Sycones, notwithstanding Zittel's want of success in displaying through thin slices the "tri- and quadriradiate spicules" of which it seems to have been composed (No. 8, vol. iv. p. 135), the preparation kindly set before me by Dr. Hinde shows a distinct triradiate in the interspaces, which would not have been there had it not come

from a Calcisponge, which most probably was the *Protosycon* itself. *Verticillites* was also a Sycone, and *Peronella dumosa* a Leucone.

Before concluding these "observations," it might be as well to direct our attention for a few moments to the structure of the fibre in the fossil Calcispongiæ. Thus in *Sestrostomella* and *Scyphia cylindrica* the large axial spicules are ensheathed in a variable number of layers, which appear to be more or less concentric and to have originated in the spicule itself, thus causing the fibre to resemble, as before stated, that of the vitreous Hexactinellida, while the pitchfork-like spicules and smaller triradiates being *in* the midst of this fibre recalls to mind what I long since pointed out in the fibre of *Aphrocallistes Bocagei* ('Annals,' 1873, vol. xii. pl. xvi. figs. 1, &c.), wherein an analogous structure is witnessed *. On the other hand, in *Verticillites* &c. there is no investment of this kind, but one of crystalline calcite, which seems to have arisen from the presence of a calcifying *lye*, probably produced by a partial dissolution of the calcispicules themselves; for this is the condition in many instances, where hardly enough of the triradiates remain to verify their existence.

P.S. Since writing the above I have had the pleasure to receive from Dr. Harvey B. Holl, of Claines, near Worcester, four slides of *Verticillites anastomans*, showing that the reticulated structure of this little fossil is formed of triradiate spicules arranged around polygonal interstices, precisely like and almost identical in size with those of a specimen of *Grantia compressa* now before me, and exceedingly well shown in Dr. Bowerbank's illustration (No. 1, vol. i. pl. xxi. fig. 313). This, then, besides confirming Dr. Hinde's discovery of a similar structure in his *Verticillites D'Orbignyi* (No. 14, vol. x. p. 192), shows that a true Calcisponge like those of existing species, although extinct in general form, may, as Zittel was the first to proclaim, be fossilized. Whatever doubts, therefore, that I have before expressed respecting this must now be repudiated.

But Mr. Holl's preparations show more than this, and were kindly forwarded to me to point out that the fibre in *Verticil-*

* Can it be possible after all, that this concentric lamination is mineral and not organic—that is, that the calcareous layers are but a reproduction in *form* of the original spicules, which, during fossilization, have become dissolved and furnished this solution for the new structure (as often seen in the chalcedonization of the vitreous sponges, or as agatoid layers round a grain of extraneous matter? The examination of another slice of my specimen of *Sestrostomella* from the Jura strongly inclines me to this view.

lites anastomans was confronted by *pinlike* spicules situated in the outer layer of calcite, with their points directed *inwards* towards the core of triradiates, and their heads *outwards*.

Now, as I have long since asserted—and have endeavoured subsequently to show in *Rhaphidotheca Marshall-Hallii*, Kent ('Annals,' 1878, vol. i. p. 170; and Journ. Roy. Microscop. Society, 1879, vol. ii. p. 497, pl. xvii. *a*)—that the *points* and *not* the heads of spicules are *always* directed outwards in the Spongida when they have been formed by the sponge itself, it follows that these little pinlike spicules have, in all probability, been in like manner appropriated by the *Verticillites*, and therefore form no part of its original spiculation.

But as no pinlike spicules have ever been found among existing Calcispongiæ, while they are abundantly present among the Silicispongiæ, it also tends to the conclusion that these were also siliceous, but have been transformed into calcite by the calcareous *lye* which, as I have before stated, in most instances half dissolved the spicules of the Calcisponge itself.

These pinlike spicules are about 30-6000ths inch long by 1-6000th inch thick in their greatest dimensions, and in appearance very much like those of *Terpios fugax* ('Annals,' 1882, vol. ix. p. 355, pl. xii. fig. 29); only the latter are a little thinner and longer, besides being slightly curved, which the former do not appear to have been. This sponge, or one allied to it, might, as it is of extreme thinness, have been supposed to have grown over the surface of the *Verticillites*, as it is its wont to do over corals &c. of the present day; but then the points would have been *outwards*, which is not the case in Dr. Holl's specimen. They are not figured by Dr. Hinde as present in his *Verticillites D'Orbignyi*; nor have I seen such in *my* specimens of *Verticillites anastomans* from Farringdon.

EXPLANATION OF PLATE I.

N.B.—No. 4 is on the scale of 1-48th to 1-1800th inch; Nos. 5-12, on the scale of 1-48th to 1-6000th; No. 13, magnified eight times; No. 15, a diagram on the scale of 1-24th to 1-1800th; Nos. 16 and 17, on the *same* scale, viz. 1-48th to 1-6000th inch, to show their sizes *relatively*.

Fig. 1. ? *Scyphia cylindrica*, var. *baculata*, Quenstedt. Lateral view. Natural size.

Fig. 2. The same. Aperture of cloacal canal. (This is grooved in some specimens and plain in others. Nat. size.)

Fig. 3. The same. Vertical section of the lower third, showing the end of the cloacal canal and the larger branches of the excretory system which opened into it. Nat. size.

Fig. 4. The same. Fragment of the fibre, as seen in a polished surface of the fossil under a microscopic power of about 150 diameters.

Fig. 5. The same. Fragment of fibre in a thin slice, mounted in Canada balsam, as seen by transmitted light under a microscopic power of about 125 diameters. *a*, shaft of axial spicule (? of a colossal radiate); *b*, short conical arm, or spur, projecting from it, showing in this instance that it is *spiniferous*; *c*, edges of the laminæ, forming the fibre outside the axial spicule, crenulated.

Fig. 6. The same. Showing that the outer layer of the fibre may be tubercled. *a*, axial spicule; *b*, edges of fibre-laminæ.

Fig. 7. The same. Showing two rays or spurs near each other on the same axial spicule. *a*, axial spicule and spurs; *b*, edge of fibre-lamina.

Fig. 8. The same. Showing that the fibre-laminæ may also project spurs. *a*, axial spicule, bearing one spur; *b*, fibre-laminæ, bearing two spurs near each other.

Fig. 9. The same. Showing that the fibre-lamina follows the form of the spur on the axial spicule. *a*, axial spicule and spur; *b*, fibre-lamina.

Fig. 10. The same. Showing that the axial spicule is composed of concentric laminæ. *a*, axial spicule; *b*, fibre-laminæ.

Fig. 11. The same. Showing the arms of a tri- or quadriradiate spicule in the axis of the fibre. *a*, radiate spicule; *b*, fibre-lamina.

Fig. 12. The same. Showing spurs and crenulated laminæ close to the axial spicule. *a*, axial spicule; *b*, fibre-lamina.

Fig. 13. *Leucetta clathrata*, n. sp., on a foliaceous coralline. *a*, Calcisponges. Nat. size.

Fig. 14. The same. Magnified eight diameters, to show the vermiculo-reticulation of the clathrous structure on the surface. *a*, osculum.

Fig. 15. The same. Surface of vermiculo-reticulation, to show that it is composed of spicule No. 16, covered in by No. 17. *a a*, summits of No. 16; *b b*, lateral view of the same; *c c*, No. 17.

Fig. 16. The same. Colossal triradiate or tripod spicule. Lateral view.

Fig. 17. The same. Smaller triradiate of the staple kind. Horizontal view. (Both of the average largest size, magnified equally, to show their relative dimensions.)

IV.—*On Specimens of the Gephyrean* Hamingia arctica, *Kor. and Dan., from the Hardanger Fjord.* By E. Ray Lankester, M.A., F.R.S., Professor in University College, London.

In the 'Zoology (Gephyrea) of the Norwegian North-Atlantic Expedition,' published at Christiania in 1881, the distinguished Norwegian naturalists Koren and Danielssen, who have so long and so well worked together, describe, amongst other interesting novelties, a very remarkable Gephyrean allied to *Bonellia*, of which a single specimen came into their hands, having been dredged two hundred miles north of the North Cape. They gave to this the name *Hamingia arctica*. Later in the same year (1881) Dr. Horst, of Leyden, described (Niederl. Archiv für Zoologie, Supplementband i.)

two specimens of *Hamingia*, placed in his hands by the committee of the "Barents" Dutch Arctic expedition, which were obtained in very nearly the same latitude as that described by Koren and Danielssen. Dr. Horst was able to add some particulars as to the vascular system and alimentary canal to the very precise and full account of the anatomy given by Koren and Danielssen. He has, however, without assigning any definite reasons, given to his specimens a new specific name "*glacialis*." There is, it seems to me, no ground for supposing that Dr. Horst's specimens belong to a new species.

The summary of characters given by Koren and Danielssen is as follows. It must be remembered that the conclusions of the Norwegian zoologists are derived from the study of a single specimen preserved in spirit.

Generic Characters.

"Body cylindrical; mouth at the anterior extremity nearest the ventral surface. Anal opening in the centre of the posterior extremity. A lunate somewhat prominent fold round the mouth (rudimentary proboscis). On the anterior portion of the ventral surface two long, cylindrical papillæ, having each at the apex a round aperture for the efferent duct of the corresponding uterus. No bristles.

"The intestinal canal with numerous circumvolutions, but no spiral coil; it disembogues into a cloaca, from both sides of which issues a ramifying glandular apparatus.

"The central nervous chord smooth, destitute of nodes or ganglions.

"One ovary protruding along the nervous chord in the posterior half of the perivisceral cavity.

"Two uteri, each with an efferent duct and funnel-shaped tube.

"The male as yet unobserved."

Specific Characters.

"Body cylindrical, smooth, 120 millim. long, 20 millim. thick, repeatedly changing its form as it contracts and expands. *Colour* a lighter or darker grassy green. Buccal disk whitish yellow; the arcuate papillæ on the ventral surface greenish with whitish yellow extremities."

Occurrence of new Specimens.—In the month of August of this year (1882), which I spent in dredging at Lervik, at the mouth of the Hardanger Fjord, in company with the Rev. Alfred Norman and Mr. A. G. Bourne, a specimen of *Hamingia arctica* was brought up in the dredge. The specimen was dredged on a rocky bottom, at about 40 fathoms depth, just

outside the harbour, south of the lighthouse island. The spot was nearly the same as that where, two years previously, Mr. Norman had dredged "a *Bonellia*-like Gephyrean," which he has had the great kindness to place in my hands for examination since our return to England. This specimen also proves to be a *Hamingia*.

Proboscis or Frontal Hood.—At first sight I was inclined to suppose that the Gephyrean dredged this summer was *not Hamingia*, but a *Thalassema*. It was about half the size of Koren's and Danielssen's specimen, of a bright apple-green colour, and had a *long contractile proboscis resembling closely that of* Thalassema *and* Echiurus. The proboscis, when extended, was as long as the body, each measuring about an inch and a half in length when thus extended. As is shown above, Koren and Danielssen have made the *absence* of a proboscis or frontal hood a leading character of their genus *Hamingia*. Dr. Horst describes one of his specimens as possessing a rudimentary proboscis. As is well known, the proboscis or frontal hood is very readily broken away in *Echiurus*; and its absence has before now led to erroneous conclusions. Quite recently Sluiter has shown that *Sternaspis* is normally provided with a large bilobed frontal lobe corresponding to the proboscis of *Echiurus*, though it has been broken off in every specimen hitherto described, and its existence not even suspected.

Shape of Body.—The movements of the body and its alterations of form in the living state closely resembled the movements and changes of shape of *Thalassema neptuni*, Gärtner, which I have observed in large numbers on the coast of Devonshire. Indeed I should have concluded from the examination of external characters that the specimen was a green-coloured *Thalassema*, differing only from other *Thalassemæ* in the *absence of genital setæ*.

Uterine Pouches and Ova.—On dissection, however, the identity of our specimen with *Hamingia* became quite certain. In place of the four or six uterine sacs present in *Thalassema* there was a single pair present, having very delicate transparent walls, unlike those of *Thalassema*. The ova and the ovaries were unlike those of *Thalassema*, and presented the same peculiarities as those of *Bonellia*, and thus corresponded with the description of Koren and Danielssen.

Cloacal Trees.—Further the "cloacal trees," or "nephridia," were found to differ from the simple pouches which occur in *Thalassema*, and to agree with those of *Bonellia* in being branched, as described and figured by Koren and Danielssen in their specimen.

Red Corpuscles of Cœlom.—One important fact I was able

to add to the description of Koren and Danielssen besides the existence of a *Thalassema*-like proboscis, owing to my specimen being in the fresh state. This was the existence in the liquid of the body-cavity of corpuscles impregnated with hæmoglobin. These corpuscles were so abundant as to give the perivisceral fluid a bright blood-red colour. I had previously (Zool. Anzeiger, 1881, no. 87) published a similar observation with regard to *Thalassema neptuni*. In *Bonellia* I can state, from my own observations made at Naples in 1874, that the perivisceral fluid is colourless. It also appears to be colourless in *Echiurus*.

Mr. Norman's Specimen.—The second specimen of *Hamingia* from Lervik, namely that dredged by Mr. Norman two years ago, came into my hands well preserved in spirit. It was a little larger than that dredged this summer. It had suffered in regard to the proboscis, as is so usual in preserved specimens of the Echiuridæ*. A very short remnant of the base of the proboscis only was preserved, thus agreeing with the specimens studied by Koren and Danielssen and by Dr. Horst.

Single Uterine Pouch.—The most remarkable fact about this second specimen was that only *one* genital papilla and one genital orifice was present instead of *two*, as in all the other specimens of *Hamingia* described. Corresponding to this single orifice was a single uterine pouch. This abnormality brings us to a condition which is normal in *Bonellia*, where only one uterine pouch is found. At the same time it is worth noting that the very delicate hyaline walls of the uterine pouch of *Hamingia* (though muscular) differ from the thick dense walls of that of *Bonellia*, as also does the internal orifice or funnel. Abnormalities in the number of uterine or spermatic pouches are not uncommonly to be observed in *Thalassema neptuni*.

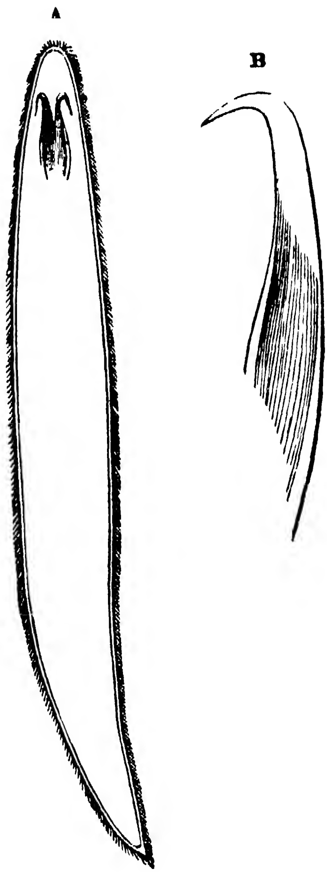
The Male of Hamingia.—In this second specimen of *Hamingia* (Mr. Norman's) I was fortunate enough to discover the male sex. As in *Bonellia*, so in *Hamingia* the male is a minute worm-like creature which lives as a parasite upon and in the female. I found five of these minute males (each $\frac{1}{12}$ inch long) within the dilated pharynx of the female *Hamingia*. I did not find any males in the uterine pouch, which was distended by fully formed eggs and was nearly as long as the whole body.

* I may mention in illustration of this fact, and as explaining the mistake made by Koren and Danielssen, that in a collection of twenty well-preserved specimens of *Echiurus unicinctus* from Japan, brought home by the 'Challenger,' not one had the proboscis in place; all showed a crescentic ridge whence the proboscis had been broken away, as in Koren and Danielssen's *Hamingia*.

The males closely resemble those of the "*Bonellia minor*" of Marion, as figured by Vejdowsky in a woodcut in his memoir "Ueber die Eibildung und die Männchen von *Bonellia viridis*, Rol." (Zeitschr. wiss. Zool. vol. xxx. p. 495). Every one of my five male *Hamingiæ* is provided with a pair of long recurved hooks (woodcut). The surface of the body is uniformly ciliated. Beyond this the condition of the specimens does not enable me to give any details, excepting that there is a spermatic pouch which opens in front of the hooklets.

The existence of a hook-bearing male is of special interest in relation to the fact that *Hamingia* stands alone among the Echiuroidea in having no genital setæ near the genital papillæ of the female.

It is also of importance as tending to remove any lingering doubt (such as was lately suggested by Greeff) as to the nature of the organisms described by Kowalevsky as the males of *Bonellia*.



Male of *Hamingia arctica.*

A. Whole animal, showing the two hooked setæ and the ciliated cuticle. Size $\frac{1}{8}$ inch long.
B. A single seta, more highly magnified.

Further, it is hereby shown that *Hamingia*, which differs in so many respects from *Bo-* ... and tends rather to agree with *Thalassema*, is, in respect of its male, in the same case as the former genus.

Characters of Hamingia, Thalassema, *and* Bonellia.—I will now briefly compare the three genera *Hamingia*, *Thalassema*, and *Bonellia*, as to some of their chief characteristics. This is most easily done by means of the tabular statement here following.

Hamingia.	Thalassema.	Bonellia.
1. Shape of body elongate, cylindrical, tapering towards anus.	1. Same as *Hamingia*.	1. Shape of body subspherical, depressed on neural face.
2. Frontal hood (so-called proboscis) as long as body when stretched, tapering towards the free end, narrow and trough-like.	2. Same as *Hamingia*.	2. Frontal hood much longer than the body, having a narrow trough-like stalk and a widely expanded caryophyllaceous anterior region.
3. Uteri and female genital pores one or two, each opening on a well-marked papilla.	3. Uteri and female genital pores four or six, not opening on papillæ.	3. Uterus and female genital pore single, not opening on a papilla.
4. Male exceedingly minute, parasitic on female.	4. Males and females alike in size and colour.	4. As in *Hamingia*.
5. Genital setæ absent in the female, present *posteriorly* to the genital pore in the diminutive male.	5. A pair of strong genital setæ in both male and female in *front* of the genital pores in both male and female.	5. A pair of strong genital setæ in the female in *front* of the single genital pore; absent in the male of *B. viridis* and present as in *Hamingia* in *B. minor*.
6. Ova enclosed in a capsule of "follicle-cells" with a mass of nutrient cells attached.	6. Ova *not* enclosed in follicle-cells (at any rate in *T. neptuni*!); nutrient cells attached.	6. Ova as in *Hamingia*.
7. Mature ovum divisible into an outer "nutrient" zone of vacuolated protoplasm and an inner denser protoplasm.	7. Mature ovum more nearly homogeneous.	7. Mature ovum as in *Hamingia*.
8. Uterine pouch or pouches when filled with eggs have delicate hyaline walls.	8. Uterine pouches even when distended have firm resistant walls.	8. Wall of uterine pouch very solid.
9. Internal opening of uterine pouch a plicated funnel with ciliated surface.	9. As in *Hamingia*, except in some species, where it is drawn out into a long spiral trough.	9. Internal opening of uterine pouch firm, like the mouth and neck of a bottle.
10. Anterior portion of pharynx dilated.	10. Anterior portion of pharynx *not* dilated.	10. As in *Hamingia*.
11. Cloacal nephridia divided into lobes or branches; nephrostomes mounted on long stalks.	11. Cloacal nephridia simple sacs; nephrostomes on short stalks.	11. As in *Hamingia*.
12. Corpuscles of the perivisceral fluid coloured red by hæmoglobin.	12. Same as in *Hamingia* in one species (*T. neptuni*); probably not so in others.	12. Perivisceral fluid colourless.

It is thus seen that *Hamingia* is really intermediate in its combination of characters between *Bonellia* and *Thalassema*.

Owing to their not having known the frontal hood or proboscis of *Hamingia*, Koren and Danielssen have somewhat overestimated the closeness of its relationship to *Bonellia*. On the whole it may be said that *Hamingia* has in internal organs a closer resemblance to *Bonellia*, in external shape and characters a closer resemblance to *Thalassema*.

The feature in which it is quite peculiar is in the absence of genital setæ in the female and the correlated existence of one or of two prominent papillæ which carry the genital pore or pores.

Summary.—The new facts which have been above recorded additional to the observations of Koren and Danielssen and Horst are briefly as follows:—

1. *Hamingia arctica* occurs on the Norwegian coast in latitude 60°, and at the comparatively small depth of 40 fathoms.

2. *Hamingia* has a frontal hood or proboscis resembling that of *Thalassema*, which is easily broken off as in *Thalassema* and *Echiurus*.

3. The corpuscles of the perivisceral fluid of *Hamingia arctica* are coloured red by hæmoglobin.

4. The male of *Hamingia* is a diminutive parasite living upon the female, as in the case of *Bonellia*; it is provided with a pair of large genital setæ, although such setæ are absent in the female.

5. Though usually there are two, yet there *may* be only one uterus and one genital pore, as in *Bonellia*.

V.—*The Theory of Mimicry and Mimicking Theories.* By W. L. Distant.

In the last issue of this Magazine (vol. x. p. 417) an article on the interesting subject of "Mimicry between Butterflies of Protected Genera," by Mr. R. Meldola, appears to be inspired by two short opinions of my own published elsewhere; and as the author has done me the honour of subjecting those views to a critical and somewhat trenchant analysis, it becomes necessary to point out that some of his strictures (in the present absence of supporting facts) appear to belong to the armoury of what may be called "forensic biology," and represent arguments which may ultimately prove to be both

important and true, but which at the present time are of a purely speculative character.

After a careful perusal of Mr. Meldola's article, it appears also, and to my surprise, that it is necessary for me to repeat that, from the time I was cognizant of the theory of "Mimicry," as formulated by Mr. Bates, as understood and enunciated by Mr. Darwin*, and proved by the recorded observations of naturalists, and the corroborative explanation given thereby to previously inexplicable entomological phenomena, I could not but believe, and have always expressed my faith, in that doctrine. It was, however, always clearly perceived that "mimicry," like its far greater and parental relative "natural selection," though affording an answer to a great mass of hitherto inexplicable biological phenomena, still did not explain every thing; and few evolutionists would, in the present state of our knowledge, expect such a consummation; and the extension of the theory of "mimicry," on lines not laid down by its founder, and unsupported by facts, must still, however reasonable in appearance and desiderated in philosophy, bear the same amount of healthy scepticism that has hitherto helped to make our knowledge what it is. Judging from the careful, painstaking, and cautious observations made by those two distinguished naturalists, A. R. Wallace and Fritz Müller (on whose behalf Mr. Meldola appears as an advocate), I think we may conclude that they also would not express impatience at usual scientific caution.

In the spring of this year Mr. Wallace published† a statement of the expressed views of Fritz Müller as to a possible extension of the theory of mimicry amongst butterflies of the same genus, which he accepted as an explanation of what he had hitherto understood with Mr. Bates as due to "unknown local causes." In the course of a most interesting argument (for Mr. Wallace is a travelled naturalist and has worked as a specialist in Rhopalocera) he stated that though it had been "suggested that young birds have an hereditary instinct, enabling them to distinguish uneatable butterflies antecedent to experience," yet it seemed "in the highest degree improbable." Upon this point alone, without reference to the other portion of the subject, I thought it at least opportune to remind Mr. Wallace ‡ of what I felt he must be aware, but had probably for the moment overlooked, viz. the very careful experiments made by the late Mr. D. A. Spalding in proving the inherited acquisition of ideas and experience in young chickens.

* 'Descent of Man,' 2nd edit. p. 323.

† 'Nature,' vol. xxvi. p. 86.

‡ 'Nature,' vol. xxvi. p. 105.

It will, however, be well, in the first instance, to deal with the term "instinct." As by some of the old French philosophers unlearned in geology the existence of fluviatile or marine organic remains on mountain-top or inland highland was denied for fear they should be used as arguments for the "Noachian flood," so, on the other hand, was the phenomenon called "instinct" often denied, in order to discountenance the views of the teleologist. Now, as Mr. Meldola has appealed to psychology, he will probably agree with me in accepting Mr. Spencer's doctrine of "inherited acquisition" as the best explanation of what we at present understand by "instinct;" and we can then estimate how far Mr. Spalding's experiments went to show that there was an inherited acquisition of ideas and experience in young chickens and turkeys to recognize and avoid inedible and sting-possessing insects.

It is unnecessary to occupy space by describing the painstaking and accurate method pursued by Mr. Spalding in these investigations. Both chickens and turkeys gave evidence of "instinctive fear of these sting-bearing insects;" but, as the investigator candidly admitted, and as I quoted him, "the results were not uniform, and perhaps the most accurate general statement I can give is, that they were uncertain, shy, and suspicious." Now it seemed to me then (and I cannot say that Mr. Meldola has removed the impression), that if young poultry, not dependent upon insect food, can yet exhibit such strongly inherited acquisitions of ideas and experience in recognizing inedible insects (Mr. Spalding showed that they at once and with avidity attacked flies), it is not unphilosophical to predicate a much greater excess of the same in purely insectivorous birds in a state of nature.

As regards facts, we have the evidence of Bates and Belt, which has been stated with due force by Mr. Wallace himself *, that the Heliconidæ do possess an immunity from the attacks of birds, lizards, and predaceous flies; and through Dr. Müller has sent home a specimen of a *Heliconius* "which had apparently been seized when at rest by some bird, as there is a notched piece bitten out of the two fore wings," and Mr. Meldola possesses a cabinet-specimen "which is notched on both hind wings," I still think we require further evidence before accepting the novel view of "psychological ontogeny" in butterflies; and without these facts, which every candid biologist and entomologist will gladly accept when forthcoming, there is little benefit accruing to science by

* 'Natural Selection,' p. 79.

objecting to its being left as a reasonable but unproved hypothesis.

The second and larger portion of Mr. Meldola's article refers to some remarks made in my 'Rhopalocera Malayana,' respecting two species of the genus *Euplœa*. Mr. Meldola has so very fairly and accurately copied my words that I prefer to leave them in context with his own views, and have nothing to add or retract; and as he has concluded that in the Malay Peninsula the scarce *E. Distanti* is the mimic of the somewhat abundant *E. Bremeri*, I will only make the following remark:—*E. Distanti* is found both in the Malay Peninsula, Java, and Sumatra, whilst *E. Bremeri* is unknown from the last two habitats, though plentiful in the first. Consequently in Java and Sumatra it mimics a species which does not exist nearer than in the Malay Peninsula (that is, accepting this "mimicry" hypothesis)*. Mr. Meldola has omitted to take into consideration these divergent elements of locality, though he will find the habitats given in the publications from which he has quoted. To prove his point he has, with the mathematical skill of which he possesses no common endowment, given a numerical statement and argument which, if figures could prove biological hypotheses, would leave nothing to be desired. However, "Nature" does not readily unfold herself to this method; and it must not be forgotten that Kramer has used the same artificial means in an anti-Darwinian sense†.

The genus *Euplœa*, like several of the other large and protected American genera, exhibits groups of species with a common facies, which, at the present time, does not appear to be explained by this proposed extension of "mimicry." It is a question that is now, and has for a long time been, engaging the attention of some of our best lepidopterists, and can only be dealt with patiently and with all the facts. Such collections as are now being formed of the difficult and simulating species of the Central-American genera by Messrs. Godman and Salvin, and the results of their exhaustive examination of the same, will be, and must be, studied for an elucidation of the question. Without specimens and without special knowledge the delicate questions which are based on genera and species, as such, can scarcely be fully estimated, much less explained. My reference to the question whether these two species of *Euplœa* could be brought under the law of mimicry was due to the fact that a prominent and very excellent Eastern lepidopterist, who is specially studying that

* Of course it may be argued that the model *E. Bremeri* has become extinct in these regions.

† See abstract of same in Semper's 'Animal Life,' p. 366.

and some allied genera, had confided to me his opinion that many genera had been confused under one, and the resemblances of the species were due to mimicry. This in no way refers to views published by Fritz Müller or held by Mr. Meldola, as the contention of the entomologist in question is, that the two species do not belong to the same genus, in which he is supported by another and no inconsiderable authority; and therefore it is necessary for Mr. Meldola to decide this point, and agree with me that both species belong to one genus, before he can bring their resemblances under Fritz Müller's argument.

In discussing the possibility of "mimicry" between the two species, I remarked that in that view "we must presumably consider *E. Distanti* as the mimicked species, as it possesses a pseudo scent-gland, which may reasonably be considered as adding to its protective or uneatable character" &c. This Mr. Meldola refers to as a fallacious position, and states that "there is not the least warrant for the supposition that scent-glands or tufts have any thing to do with distastefulness," and further remarks that, as such organs exist in one sex only*, it is strongly suggestive, if not demonstrative, of the view that they are *secondary sexual characters*, and as such they are regarded by Dr. Fritz Müller.

Now, on reference to Dr. Müller's paper, to which we are directed, and which was communicated and edited by Mr. Meldola himself, we read, "the male of *Ituna* sometimes protrudes his tufts, when he is seized; so that in this butterfly the odour may serve *both to repel enemies* and to allure females"†. In discussing the scent-pouches on the posterior wings of *D. erippus*, Dr. Müller remarks that, as these organs "open only by a narrow slit, odours could hardly be freely emitted," and asks, "Might not the tufts be introduced into the pouches to be impregnated there with odoriferous matter?"‡ If so, for what purpose? Presumably for the reason given for the scented tufts of *Ituna*. Mr. Bates has also borne witness that species of *Lycorea* and *Ituna* have exsertible glands near the anus, which are protruded when the insects are roughly handled, and that "it is well known that similar organs in other families (Carabidæ, Staphylinidæ) secrete fetid liquids or gases and serve as a protection to the species"§.

* "In *Thyridia megisto*, according to Dr. F. Muller, the character of the odoriferous tuft has been transferred to the female, though in a less developed and weaker form."—Transl. by Meldola, Proc. Ent. Soc. 1879, p. xxii.

† Trans. Ent. Soc. 1878, p. 213. ‡ *Ibid.*

§ Trans. Linn. Soc. xxiii. p. 510.

I have written the above with considerable reluctance—first, because it partakes more of the nature of biological controversy than of any acquisition to our knowledge; and secondly, because I share with my old friend and late colleague, R. Meldola, so much in common in the points discussed and admiration for his sanguine and bold attachment to advanced theories and conclusions, for which his severe training in more than one branch of science and great natural abilities particularly fit him. I still, however, believe that "original work" is distinct from "original guessing," and that the most advanced evolutionist may be excused if, though he bases his conclusions on the first, he withholds his assent to the last whilst in the uncorroborated stage; and in the present discussion this is neither restricting the "original theory within such narrow limits that no philosophical entomologist can possibly accept [the] interpretation," nor does it indicate "a retrograde step which few scientific entomologists will be disposed to take."

VI.—*Description of a new Genus of* Cœciliæ. By G. A. Boulenger.

The following species is the second of the order Apoda discovered in East Africa. It is the type of a very marked genus, presenting a curious combination of characters. Its nearest ally I consider to be *Gegenophis*, from Malabar, which has likewise the skin scaleless and the eyes hidden under the cranial bones; but it is well distinguished by having the squamosal bones in contact with the parietals, two series of teeth in the lower jaw, and by the structure of the tentacle.

Scolecomorphus, g. n.

Squamosals separated from parietals. A single series of teeth in the lower jaw. Eyes overroofed by bone. Tentacle flap-shaped, situated below and slightly behind the nostril. No scales.

Scolecomorphus Kirkii, sp. n.

Teeth very small, subequal. Snout very prominent, rounded. Tentacle on a large oval swelling situated on the lower surface of the snout. Body slender; 152 circular folds, all interrupted on the dorsal and ventral lines. Tail indistinct, rounded. Dark olive above, brownish olive beneath. Total length 270 millim.; greatest diameter of body 7 millim.

A single specimen, obtained through Sir J. Kirk, probably from the vicinity of Lake Tanganyika.

VII.—*The Moths of New Mexico.* By AUG. R. GROTE, President of the New-York Entomological Club *.

DURING the last ten years our knowledge of the Lepidopterous fauna of the western and south-western regions of the United States has greatly increased. If I might connect a pleasant incident to American entomologists with this advance in their study, I should refer to Lord Walsingham's visit and the collections made by his lordship in the west as the commencement of our later progress towards a better knowledge of our fauna. Within the last few years the collections made by Mr. Morrison in Montana and Washington Territory, and again in 1882 in Arizona, together with the numerous fine species discovered by Mr. Dall in Arizona and Southern Colorado, have given us a good idea of the Lepidoptera of those regions, still difficult of access to the collector, whose journey thither from the east is an expensive one.

Two expeditions to New Mexico by Professor F. H. Snow, of the State University of Kansas, have resulted in the discovery of a proportionally large number of new species of moths. The material gathered at both times has been submitted to me; and the object of the present paper is to give a list of those species of moths collected in 1882. The specimens were taken near Las Vegas, at an elevation of about 7000 feet above the level of the sea. From his first trip Prof. Snow did not return without running some risk of a surprise by the Apaches, a tribe of Indians who are not so calculating as the brigands of Italy or Greece, but scalp and plunder the white traveller out of hand.

As might be expected, the species collected include tropical or subtropical forms; but what might not be expected is that they also offer representatives of European species not yet found near either our western or eastern sea-boards. In New Mexico and Arizona we find a mixture of species which throws some light upon the origin of our present fauna, and allows us to study the elements of which it is composed. First, we have a stronger admixture of tropical forms, as in the genus *Hyperchiria*, which no doubt is an intruder on our territory from the south. Whereas in the east we have only one species (*Io*) which, with more or less variation, extends from Maine to Texas, and penetrates to New Mexico and Colorado, we have three other species from Arizona, New Mexico, and Southern Texas respectively, viz. *pamina*, Neum., *zephyria*, Grote, and *Zelleri*, Grote and Robinson. There is next an

* Communicated by A. G. Butler.

element of Californian species, such as *Botis mustelinalis* and several Geometridæ. In Arizonian collections I have identified several species of *Phasiane* and *Semiothisa* described by Dr. Packard from California. In the present collection from New Mexico there are also eastern species, such as *Hyperchiria Io*, *Hadena fractilinea*, *Mamestra detracta*, *Heliophila commoides*, *Phibalapteryx intestinata*, &c. We have next species proper to New Mexico and Arizona, so far as we can judge, such as *Halesidota ingens* and *H. ambigua*, also *Heliophila bicolorata*, *Agrotis beata*, *A. grandipennis*, and *A. circumdata*, with *Marmopteryx sponsata*, *Aspilates viridirufaria* (one of the finest Geometridæ known to me), and several other species. Forms hitherto known to us from Texas, as *Idæa peralbata*, are also represented. But the species which offers the greatest interest is a Noctuid, *Copimamestra occidenta.* This species represents the European *Copimamestra brassicæ* —tibial claw, hairy eyes, style of marking and all. Following out the theory which I have strengthened in various papers, we must regard such species as the remains of a former circumpolar tertiary fauna. The modifications which have taken place in the two branches of the species, separated by the ice-period and the forcing of the faunas southward, are sufficient to enable us to recognize them today as distinct "species" under different names.

Before proceeding with the list of Prof. Snow's captures, I give a brief summary of the characters which I have used in erecting genera in the Noctuidæ. I have worked at this group, in the United-States fauna especially, during the last twenty-five years, and have found occasion to propose some ninety-five genera, chiefly in the main division of the family as it is represented in temperate regions, the Noctuinæ or Nonfasciatæ. As affording absolute generic characters, admitting of no rational dispute, I regard the structure of the clypeus, the hairy or naked eyes, the peculiarities of the body-vestiture, the venation, the armed or unarmed tibiæ, and the structure of the front tibiæ. As comparative characters of less value, but which still may be relied on in default of better, I regard the relative length of the labial palpi and tongue, the presence or absence of ocelli, the antennal peculiarities, the relative length of the abdomen, and the shape of the wings. Genera established upon secondary sexual characters, such as *Heliochilus*, Gr., I am inclined to believe valid. Not only are they sanctioned by older authorities, but by neglecting them we lose sight of interesting facts, such as the occurrence of *Heliochilus*, for instance, in Asia as well as North America, whence I at first described it. The gradual unfolding of

our Noctuid fauna before me, from the time when there were not half a dozen species correctly named in our museums, a quarter of a century ago, to the present, when we have more than fifteen hundred species recorded and more or less well known, has necessitated a continual correction of my views. A few of my genera have been shown to be the same as European—as *Acerra*, which equals *Perigrapha*. Others I have discarded after the discovery of forms bridging over differences; and again, in my search for points of distinction, I have lost sight of characters of resemblance or agreement at the time of describing the new genus. A comparison of the Noctuidæ of North America and Europe will finally show that certain European species belong to genera established upon American types. I think that after the discovery of *C. occidenta* the genus *Copimamestra* must be accepted for *brassicæ* on the strength of the tibial claw. Superficial resemblances must not be confounded with coincident structure. When we examine the nervulation we must separate the American genus *Sparagmia*, with its twelve species, from the European *Erotyla*, with only one; here the narrower wing and modified clypeus also assist us. The American genera *Eucirrœdia* and *Ripogenus* are probably valid on a careful study of *Cirrœdia* and *Eutelia* of Europe, although the members of these genera look much alike. In the North-American Noctuid fauna the remarkable features are the number of species of *Agrotis*, *Oncocnemis*, and *Catocala*; and again, the number of genera, such as *Fishia*, *Homohadena*, *Trichorthosia*, *Homoglœa*, *Trichocosmia*, &c., which are founded upon different combinations of characters offered by such old and accepted genera as *Agrotis*, *Hadena*, *Mamestra*, *Glœa*, and *Orthosia*. The number of strongly-marked Heliothid genera is also well worthy of note.

In concluding this brief introduction, I wish to mention that Professor Snow's work in the different branches of zoology reflects credit upon the institution which he represents in this department of natural science.

List of Species.

Smerinthus gemmatus, *Say*.
Sphinx Oreodaphne, *Hy. Edw.*
—— lugens, *Walk.*
Alypiodes flavilinguis, *Grote.*
Pygoctenucha Harrisii, *Boisd.*
—— funerea, *Grote.*
Lycomorpha constans, *Hy. Edw.*
Harrisina americana, *Har.*
—— coracina, *Clem.*
Triprocris Smithsonianus, *Clem.*
Nola fuscula, *Grote.*
Crocota ferruginosa, *Pack.*
—— quinaria, *Grote*, var.
—— brevicornis, *Walk.*
Halesidota ingens, *Hy. Edw.*
—— ambigua, *Streck.*
Alexicles aspera, *Grote.*
Nadata gibbosa, *Abb. & Sm.*

Œdemasia perangulata, *Hy. Edw.*
Telea Polyphemus, var. oculea, *Neum.*
Hyperchiria Io, *Fabr.*, var.
—— zephyria, *Grote.*
Apalela extricata, *Grote.*
—— noctivaga, *Grote*, var.
—— thoracica, *Grote.*
Agrotis Conchis, *Grote.*
—— planalis, *Grote.*
—— bimarginalis, *Grote.*
—— cupidissima, *Grote.*
—— orbis, *Grote.*
—— auxiliaris, *Grote*, var.
—— grandipennis, *Grote.*
—— circumdata, *Grote.*
—— beata, *Grote.*
—— saucia, *Hubn.*
Copimamestra occidenta, *Grote*
Mamestra discalis, *Grote.*
—— detracta, *Walk.*
—— acutipennis, *Grote.*
—— gnata, *Grote* (♀).
Hadena auranticolor, *Grote.*
—— perpensa, *Grote.*
—— hausta, *Grote.*
—— fractilinea, *Grote.*
Perigea loculosa, *Grote.*
—— albolabes, *Grote.*
Homohadena epipaschia, *Grote.*
Polia illepida, *Grote.*
Tricholita semiaperta, *Morr.*
Heliophila bicolorata, *Grote.*
—— albilinea, *Hubn.*
—— commoides, *Guén.*
Trichorthosia parallela, *Grote.*
Tæniocampa agrotiformis, *Grote.*
—— thecata, *Morr.*
Lithophane signosa, *Walk.*
Ingura præpilata, *Grote.*
Adipsophanes miscellus, *Grote.*
Caradrina meralis, *Morr.*
Rhodosea Julia, *Grote.*
Grotella Dis, *Grote.*
Euclidia intercalaris, *Grote.*
Cirrhobolina mexicana, *Behr.*
Catocala violenta, *Hy. Edw.*
Toxocampa victoria, *Grote.*
Homopyralis discalis, *Grote.*
—— miserulata, *Grote.*
Spargaloma sexpunctata, *Grote.*
Pseudanthracia coracias, *Guén.*
Epizeuxis americalis, *Guén.*
Prochœrodes catenulata, *Grote.*
Tetracis Grotearia, *Packard.*
—— simpliciaria, *Grote.*
Caberodes marjoraria, *Guén.*
Metrocampa margaritata, *Linn.*
Ellopia vitraria, *Grote.*
Idæa peralbata, *Pack.*
Deilinia erythemaria, *Guén.*
Phasiane cruciata, *Grote.*
Marmopteryx sponsata, *Grote.*
Thamnonoma perpallidaria, *Grote.*
Fidonia peralternaria, *Grote.*
Caripeta æqualiaria, *Grote.*
Aspilates viridirufaria, *Neum.*
Eubyja mexicanaria, *Grote.*
Lobophora inæqualiata, *Pack.*
Baptria? albofasciata, *Grote.*
Phibalapteryx intestinata, *Guén.*
Eupithecia cretaceata, *Pack.*
Paraedis obliqualis, *Grote.*
Asopia olinalis, *Guén.*
—— cohortalis, *Grote.*
—— planalis, *Grote.*
Botis mustelinalis, *Pack.*
Blepharomastix renalis, *Guén.*
Nephopteryx auranticella, *Grote.*
Crambus dimidiatellus, *Grote.*

Descriptions of Species.

Hyperchiria zephyria, Grote.

This fine species has deep-fuscous or blackish fore wings and thorax, the former with an oblique white stripe or band, vividly contrasting, running from costa at apex to internal margin near the middle. The white spots at base of primaries are distinct. Hind wings with the disk yellow and the ocellus as in *Io*; beyond the wing is pale fuscous, with clouded shading. Abdomen shaded with red, as with *pamina*; more wholly red above in the male.

Telea Polyphemus, var. *oculea.*

Mr. Neumoegen has described this variety from Arizona. The ocellus on fore wings is ringed with blue behind, and set in a cloud of black as on hind wings in the usual form. The specimen collected by Prof. Snow has the black cloud reduced as compared with Mr. Neumoegen's Arizonian types.

Agrotis bimarginalis, n. s.

Allied to *variata* and *observabilis*. Head and thorax rich orange-brown; a broad pale leather-brown or fawn-coloured costal stripe to terminal posterior line; terminal space frosted with white. Rest of the wing deep brown, shaded with black. Terminal posterior line even; stigmata obscured by the blackish shading; subterminal space black on costa. Hind wings pale fuscous; abdomen brownish terminally. Beneath with dots and a common even exterior shade band. No. 924. *Expanse* 36 millim.

Agrotis circumdata, n. s.

Belongs to the *gravis* group, the handsomest species yet found of this group. Terminal space light leather-brown, and joining an equally broad similar band along internal margin, which is edged above and below by two deep velvety black curved longitudinal stripes at base of wing. These bands vividly contrast with the black subterminal space and brownish-black surface of the wing. The dentate terminal anterior line and even terminal posterior line partly visible. Stigmata contrasting; orbicular small, pale, with dark central dot; reniform small, pale, upright, not constricted, with brown line. Head and collar rich ochre-brown; thorax blackish. Hind wings fuscous, with reddish fringes. Beneath powdered with reddish brown, common band and discal dots distinct on secondaries. No. 925. *Expanse* 35 millim.

Agrotis planalis, n. s.

♂. Allied to the *Normaniana-esurialis* species. Fore wings and thorax concolorous dark chestnut-brown; subterminal line narrow, commenced in black, with a subcostal tooth pointing inwardly, thence straightly, indistinctly scalloped to inner margin. Lines double, marked on costa; terminal posterior line faint, not much bent; stigmata small, concolorous, set in a black discal shade. Thorax a little darker than primaries above. Beneath distinctly marked. Fore wings blackish to subterminal line, beyond which the terminal space is pale; outer mesial line marked on costa; hind wings pale, with dis-

tinct extramesial line and discal dot. Abdomen brownish. Hind wings above without well-defined lines, paler at base, shaded broadly with fuscous outwardly. Antennæ slightly pectinate. No. 1043.

Agrotis grandipennis, n. s.

One of the largest species, the female expands 52 millim. Rich purplish red-brown, veins marked incompletely with black, terminal black marks distinct. Terminal anterior line dentate, a large submedian tooth, double lines fine, black. Orbicular small, round, pale, with dark dot; a dash connects it with the shadowy reniform. Terminal posterior line marked by double costal black dots, else obsolete. Hind wings pale fuscous, veins marked. Abdomen shaded with reddish; thorax like fore wings. Beneath whitish with well-defined dots. Nos. 948 and 949. All the tibiæ spinose. Allied to *piscipellis*.

Agrotis beata, n. s.

Delicate dark mouse- or pigeon-grey; belongs to the *anicla* group. A black velvety band or collar in front. Lines single, faint and narrow. Terminal posterior line forming a single angle. Subterminal line pale, preceded above by a black shading, and followed by a narrow black shade. Median shade diffuse, black. Fringes pink. Hind wings nearly white, smoky outwardly. Beneath without lines or dots. Head and thorax grey, like primaries. Abdomen pale grey, somewhat reddish at tip and beneath. No. 929. A lovely species. *Expanse* 36 millim.

COPIMAMESTRA, n. gen.

This agrees with *Mamestra*, except that the fore tibiæ are armed with a distinct large claw. Eyes hairy. Abdomen tufted. Tibiæ unarmed. The types are the European *C. brassicæ* and the following new species:—

Copimamestra occidenta, n. s.

Darker and more blackish than *brassicæ*. A greenish white broad band before the subterminal line, continuous. Reniform greenish white. A patch of the same colour on subbasal field. Orbicular not well defined. Median lines black. Tegulæ lined with black. Hind wings pale, shaded outwardly with blackish. Beneath, the discal spot on fore wings is pale with central dot. The whitish secondaries show a well-defined dot. *Expanse* 42 millim. No. 943.

Grotella Dis, n. s.

This species seems a little larger than 7-*punctata*, with the dots obliterated on the white primaries. Unlike the latter, the hind wings are black with white fringes. Beneath also black, the white fringes on both wings strongly contrasting. I have been disposed hitherto to regard this as a variety. One specimen also in Mr. Neumoegen's collection from Arizona. *Expanse* 26 millim. New Mexico. No. 1018.

The contrast between the white primaries and blackish secondaries on the upper surface is peculiar. If only a variety, it is one worthy of a separate designation.

PROCHŒRODES, Gr.,=*Eutrapela*, Packard.

According to Mr. Butler, the genus *Chœrodes* is preoccupied in Coleoptera. I have shown, in the 'Canadian Entomologist,' that *Eutrapela* is used by Hübner first for a species of *Selenia*; and, in including *clemataria*, Hübner may have thought the moth congeneric. A new name is therefore necessary for our genus, with *transversata*, Drury, as type. Guénée's limitation of *Eutrapela* to *clemataria* is not followed by Dr. Packard, whose genus *Eutrapela* corresponds with *Chœrodes* of Guénée plus the *Eutrapela clemataria* of the 'Species Général.'

Prochœrodes catenulata, n. s.

♀. Allied to *nubilata*, but differing by the wings beneath being pale and having a continuous, even, dark outer line *dotted* or *accented* on the veins, equally distinct on both wings. All the wings show the black discal dots equally distinct above and below. Base of primaries greyish ochry, defined by an irregular brown line, bent outward on cell. Median space fawn-brown, freer from strigæ than wing elsewhere. Outer line brown, angled to costa, followed by a diffuse blackish subterminal shade, continued more faintly on secondaries. Outside the terminal posterior line, both wings greyish, as at base, and the strigæ are, here as there, again prominent. Apex acute; outer margin with a rounded angle, less defined than Packard's figure (61); hind wings with smaller angle and with the tips of the veins determinate. A larger insect apparently than the Californian species. *Expanse* 45 millim. The black subterminal clouding is continuous and reaches apex.

Phasiane cruciata, n. s.

Grey; inner line black, slightly outwardly bent at middle;

the close and parallel median shade runs straightly down, and at the bend touches it; a curved shade line before the black inner line; so that here we have three lines close together and partially fused, differing in distinctness. Outer line black, sinuous, bent outwardly on costal region, the subterminal, fainter, runs close to it, and they nearly touch opposite the cell; at the place of the subterminal line the wing is whiter, free from speckles or strigæ, also on median space. Hind wings grey, finely irrorate; two mesial lines indicated on internal margin. Beneath whitish grey, irrorate; fore wings reflecting lines. No. 1002. *Expanse* 27 millim. Easily known by the terminal anterior line forming two forks from its middle junction with the median shade. Discal dots very small.

Caripeta æqualiaria, n. s.

♀. Close to *angustiorata*. Fore wings rich rosy brown and ochry brown, the paler shadings being whitish yellow. Terminal anterior line upright, dark brownish, the cells before it to base being diffusely filled with yellowish white. This line in its ally forms a wide tooth, narrowing the median space which is here wanting, the median lines being subparallel and the median field of the same width. Two indistinct pale spots on the cell. Outer line followed by a narrow diffuse yellow-white shade, like anterior line, toothed at extremity of median vein. Subterminal line a succession of dark brownish blocks on interspaces, followed to the edge by yellow-white triangular marks. Hind wings whitish, shaded on veins with yellow. Thorax fawn. Beneath reflecting markings; hind wings with a broken ochre line. *Expanse* 38 millim. New Mexico. No. 995.

Paraedis obliqualis, n. s.

Front flat; maxillary palpi stout and scaled, as long as the labial, appearing between them and the front. Allied to *funalis*, and similarly sized. Grey, shaded with smoky and brown. Inner line single, oblique, very faint, apparently angulate on cell. Outer line parallel with this, *even* and oblique, preceded by a faint white shade. Subterminal line black, denticulate, running from apex inwardly to a point below the middle, whence it runs close and parallel to the outer line to the internal margin; it is touched with white below the middle, after which it is even and black. There is a wide brown clouding across the wing from the outer line to the external margin opposite the cell; above internal angle a large free grey space. Fringes dark. Reniform a faint,

quadrate, upright, blackish, shaded spot. Hind wings pale fuscous, with two subterminal lines: the outer is flecked with white before anal angle; and opposite this flecking the fringes are touched at their tips with black. There is a dotted line on secondaries beneath; and on fore wings the reniform is very distinct, blackish, and square. As compared with the figure of *Paraedis funalis*, N. Am. Ent. i. pl. v. fig. 4 (fore wing, sub *Ædis*, changed to *Paraedis* in "New Check List"), the *even* outer median line will distinguish *obliqualis*. Attention must be paid to the structure of the head in this and allied genera to locate the species. No. 1019.

I describe here a form from Washington Territory:—

Prorasea indentalis, n. s.

Frontal bulging less prominent than in *simalis* (N. Am. Ent. i. pl. v. fig. 2, enlarged head). A raised rim arises above clypeal plate. Grey, shaded with white at inauguration of the dark dentate outer median line, which forms a prominent tooth on submedian fold; and here again the wing is shaded with white. Outer line followed by a white shade. A white shade along submedian fold. A white square spot on cell between the stigmata. Hind wings pale fuscous, with an extra mesial line indented submedianly. A fuscous submarginal shade band. Fringes pale, with a dotted basal line, expiring before anal angle. Beneath yellowish fuscous, with two spots on cell of fore wings, the first small, elongate, the outer subequal, transverse; a common line; body white beneath. *Expanse* 34 millim. Washington Territory. Coll. A. R. Grote.

Crambus dimidiatellus, n. s.

♀. Size large. Costal region broadly olivaceous, edged by a darker linear shade below. Rest of the wing with the veins striped with white, and covered medially by a broad white shade, widening at external margin; below this the ground-colour is again somewhat olive. Hind wings and fringes pale silky fuscous. Fringes and fore wings white, faintly dotted. *Expanse* 36 millim. No. 968. Labial palpi long; approaches the *propexus* group. I do not know the male.

Nephopteryx auranticella, n. s.

♀. Although I have but a single specimen, very bright, the extraordinary colour and size will enable the species to be at once recognized, and perhaps better placed when the male

is known. Fore wings bright orange-red, colour of *caripeta*. A white somewhat diffuse longitudinal stripe from base to end of median vein, followed by a slight oblique white clouding. Subterminal line white, contrasting with the red wing, running inwards a little on costal and internal margins. The wing is more yellowish or orange at base, redder outwardly. Tegulæ and sides of collar orange. Head above and collar centrally white. Legs red outwardly; palpi red, white at base. Thorax beneath white. Hind wings pale translucent fuscous, with a fine terminal line and white fringes, interlined at base. Beneath yellowish fuscous, with a red mark on primaries at costal inception of transverse line. *Expanse* 30 millim. New Mexico. No. 1021.

This brilliant species wants the usual inner transverse line on fore wings above.

VIII.—*Report on a Journey for the Investigation of the Torpedinei extant in the Museums of England and Holland.* By Prof. GUSTAV FRITSCH*.

I TAKE the liberty of laying before the Royal Academy of Sciences the following report upon the investigations carried on by me during the month of August of the present year in England and Holland †.

As there could be no doubt that the collections of the British Museum in London would offer the greatest chance of furthering my undertaking, I travelled direct to London on Saturday, August 5, and on the following Monday I had already in my hands the desired material, as Dr. Günther had had it got ready for me, in kind compliance with my wishes expressed in writing.

Among the Torpedinei there was the typical specimen of *Torpedo hebetans*, Lowe, the characters of which made me think it probable that it was allied to *T. occidentalis*, Storer, as well as to *T. californica*, and thus led to a convic-

* From the 'Sitzungsberichte der konigl. preuss. Akademie der Wissenschaften zu Berlin,' November 23, 1882, p. 1007.

† *Note by Prof. E. Du Bois-Raymond.*—Prof. Fritsch's journey had for its object to test, upon more species of Torpedinei than Prof. Peters could place at his disposal in the museum here, the correctness of the conclusion that I had deduced from what I call the Delle Chiaje-Babuchinic proposition, namely that every good species of Torpedinei possesses as a diagnostic character a certain average number of columns. See my "Vorlaufige Bericht uber die von Prof. Gustav Fritsch in Ægypten und am Mittelmeer angestellten neuen Untersuchungen an electrischen Fischen," Sitzungsb. Akad. Wiss. Berl. 1882, pp. 487 *et seqq.*

tion that, in accordance with the law of correlation, the number of columns in the electrical organs would also be remarkably large.

It merits my most grateful acknowledgments that Dr. Günther acceded to my pressing request and allowed me to make the necessary anatomical examination of the typical specimen—an examination which established the correctness of the supposition expressed, and showed the three above-mentioned species (*T. occidentalis*, *californica*, and *hebetans*), by the structure of their electrical organs also, to be three nearly allied species. Now it will only be necessary to carry out the numeration of the columns in *T. nobiliana*, Bon., which has always been a doubtful species, in order to establish its relations to the others.

The above-indicated comparison satisfactorily confirms the agreement of the marine faunas of the Atlantic and Pacific coasts, already affirmed by Dr. Günther himself upon other investigations, as well as the diffusion of American forms of marine animals as far as the European shores.

Besides this particularly important result, I had now to ascertain the structure of the electrical organs, their proportion in the two sides of the body, and the mosaic of the columns, from the material in the museum, in a series of rare or elsewhere inaccessible species. These investigations were carried out upon the following species, the greater part of which were new to me, and most probably had never been previously examined for their electric organs—namely, *Hypnos subnigrum*, A. Dum., *Narcine tasmaniensis* (adult and embryo), *Narcine lingula*, *Narcine Timlei*, *Torpedo fuscomaculata*, *Astrape dipterygia*, and *Astrape capensis*. Sketches were made for the purpose of future comparison of the organs when exposed, as well as of their relation to the form of the body; the number of columns was ascertained in all; and the diagrams of the numerations made with copying-ink upon glass were transferred to paper.

Except *Torpedo nobiliana* (which I have never been able to get hold of, in spite of all my endeavours), no species now exists in European museums which is not represented in the tables compiled by me; and for this gratifying completion I am mainly indebted to the kind reception I met with in the British Museum*.

By constant hard work I was able to complete the above-mentioned researches in the course of a week, and then went to the Royal College of Surgeons, to ascertain whether any

* I do not know whether *T. Tschudii* exists in European collections.

thing was still extant of the gigantic specimen captured near Torbay in 1773, and described by Hunter. From my numerations in *T. occidentalis*, made in Vienna, compared with Hunter's, I had been led to regard the latter as belonging to that species.

Although in the College of Surgeons, as in the British Museum, the collections were in a state of change and renovation, I was most kindly assisted in my investigations by the officers of the establishment, and found, as the remains of the above-mentioned fish, a well-preserved preparation (Descriptive Catalogue, no. 2176) showing the cranial capsule opened, the brain, and spinal cord, as well as the system of the cephalic nerves and electrical nerves; of one of the organs (the right) the inner marginal part, where the nerves enter, is preserved. This extremely interesting historical preparation, which had been completely forgotten in England, was sketched by me of the natural size, as well as this could be done without opening the glass.

After the completion of these investigations I quitted England, seeing that there was no hope of finding in other towns any important material in a department which, even in the British Museum, was represented by *unica*. I directed my steps towards the celebrated university-city of Leyden, where the hope of finding further material seemed to be most favourable. This hope was not fulfilled, as the poverty of the Leyden collection in this department proved to be unexpectedly great. A few hours sufficed to run through the list of the electrical fishes there, and to ascertain that, even if permission could have been given to prepare them (which, owing to the absence of the officers, was not attainable), no important gap in the Table could be filled up. It is only a further confirmation of the fact that, notwithstanding many suggestive investigations, the electrical fishes are treated with great neglect by the majority of naturalists.

There was still a slight chance of obtaining further material, namely to try whether the dealers in objects of natural history in the capital had any thing of the kind for sale. I therefore quitted Leyden in the evening of the day on which I had arrived there, and took my way to Amsterdam. Contrary to my expectation, even this hope proved to be vain, as the interest there at present seems to be entirely concentrated upon living animals and plants. I could find no dealer in Amsterdam; and consequently it could be of no use to prolong unnecessarily an expensive sojourn. On the morning of the 17th I reentered Berlin.

From this latter part of my journey the most important

result appears to be that it is exceedingly desirable to interest travellers sent by the Academy, as well as other educated persons in foreign countries, in procuring the material which is so remarkably scarce in collections. It would scarcely be profitable to visit other European cities, Hamburg perhaps excepted, for the purpose of examining preserved material.

IX.—*Description of a new Species of* Anthrenus *from India* (*Coleoptera, Dermestidæ*). By CHARLES O. WATERHOUSE.

FOR many years there have been in the British Museum numerous specimens of a species of *Anthrenus* from the Himalayas. Recently specimens of the same species were sent from the Madras Presidency for determination. I have, however, failed to identify the species with any one described; I therefore venture to characterize it as new.

Anthrenus vorax.

Subrotundatus, piceus; supra squamulis ochraceis denso tectus, maculis albis notatus; subtus denso albo squamosus; pedibus piceis, femoribus ochraceis, abdominis segmentis 2°–5^{m} singulis ad latera gutta ochracea ornatis.

Long. 3¼ millim., lat. 2½ millim.

This is a very broad species, moderately convex; closely covered above with sandy ochreous, short, ovate scales. There are some whitish scales on the forehead. The scales on the sides of the thorax (except at the anterior and posterior angles) are white; but there is a yellow spot in the middle of the white patch; there are a few white scales at the middle of the base. The elytra have the following white marks:—an elongate spot on the suture at the base; a round spot at the extreme base, a little nearer the suture than the shoulder; a somewhat large triangular patch below the shoulder, generally more or less connected with the sutural mark by some white scales; a small spot close to the suture, another, larger, round spot (a little more removed from the suture) near the apex; at the side there are two small spots—one a little behind the middle, the other not far from the apex. The apical segment of the abdomen is dusky in the middle. The antennæ are pitchy red, eleven-jointed, the three apical joints forming a somewhat large, short-ovate club; the ninth joint is much smaller than the tenth, and the eleventh is distinctly larger than the ninth and tenth together.

X.—*Description of a new Species of the Lepidopterous Genus* Elymnias. By J. Wood-Mason.

[Plate II. figs. A & B.]

Elymnias Peali, n. sp.

♂. Wings above violescent black-blue, gradually darkening from the outer margin to the bases, with the markings deep lavender-blue and the incisural fringes greyish white.

Anterior wings with an oblique subapical band placed nearly at right angles to a complete submarginal series of rather faint and diffused blotches, and the apical subcostal cell, all lavender-blue, and with the costal and subcostal areas transversely striated with the same colour.

Posterior wings with a corresponding submarginal band, which is very prominent and broken up into coarse striæ between the foremost median veinlet and the abdominal margin, towards which it passes from blue into red-violet.

Wings below much as in *E. undularis* and its allies, but more richly coloured than in any of the species of that group.

Length of anterior wing 1·5, expanse 3·15 inches.

Hab. Aideo, Sibsagar district, Assam. Captured by Mr. S. E. Peal.

In form it approaches *E. timandra*, Wallace; "in coloration," as Mr. E. W. Janson informs me, "it is most like *E. penanga*, Westwood (*M. mehida*, Hew.), much less so the *E. Saüeri* of Distant, recently described and figured in his 'Rhopalocera Malayana,' p. 65, tab. ix. fig. 3, ♂."

PROCEEDINGS OF LEARNED SOCIETIES.

GEOLOGICAL SOCIETY.

November 1, 1882.—J. W. Hulke, Esq., F.R.S., President, in the Chair.

The following communication was read:—

"Notes on some Upper Jurassic Astrorhizidæ and Lituolidæ." By Dr. Rudolf Häusler, F.G.S.

The Arenaceous Foraminifera obtained by the author are chiefly from the zones of *Ammonites transversarius* and *A. bimammatus* in the Upper Jura of the Aargau; and from the whole Swiss Jurassic

formation he has determined about sixty species, including the Textularidæ. They belong to the genera:—

Psammosphæra.	Placopsilina.
Astrorhiza.	Trochammina.
Rhabdammina	Hormosina.
Marsipella.	Webbina.
Hyperammina.	Thurammina.
Lituola	Textularia (Plecanium).
Reophax.	Bigenerina.
Haplophragmium.	Valvulina.
Haplostiche.	

A few species are identical with Carboniferous or Permian forms; but most of them most nearly approach recent deep-sea species and varieties, although similar forms do not occur in the younger formations. The species described in the present paper are from the zone of *Amm. transversarius*, and are as follows:—*Psammosphæra fusca*, Schultze; *Hyperammina vagans*, Brady; *Reophax multilocularis*, sp. n.; *R. helvetica*, Häusl.; *R. scorpiurus*, Montf.; *Placopsilina arenacea*, d'Orb.; *Thurammina papillata*, Brady; and *T. hemisphærica*, sp. n. Most of the recent genera of Astrorhizidæ and Lituolidæ would seem to have been represented by species identical with, or nearly allied to, those now existing, at the time of deposition of the beds with *Ammonites transversarius*.

December 6, 1882.—J. W. Hulke, Esq., F.R.S., President, in the Chair.

The following communication was read:—

"Note on a Wealden Fern, *Oleandridium* (*Tæniopteris*) *Beyrichii*, Schenk, new to Britain." By John E. H. Peyton, Esq., F.G.S.

This fern, figured by Schenk in the 'Palæontographica' (vol. xix. plate xxix. figs. 6, 7), was discovered near Minden, in the Northwest German Wealden-beds, and appears to have been hitherto unknown in England. It was first discovered in the Wadhurst Clay ("Tilgate stone" of Mantell) of the cliffs east of Hastings, by Mr. Charles Dawson, of Warrior Terrace, St. Leonards, who has a fine collection of Wealden fossils, and was brought to my notice by Professor Augusto de Linares, of the Valladolid University, who has lately discovered the Wealden in the north of Spain.

This specimen*, which I have much pleasure in presenting to the Society for their Museum, I found about a fortnight ago, also in our local "blue stone" from the Wadhurst Clay of the Hastings cliffs.

In connexion with the flora of the Wealden, I may perhaps mention that, besides the ordinary ferns recorded by Mantell, Fitton, Topley, and others, viz. *Lonchopteris Mantelli*, *Sphenopteris*

* It varies slightly from the one figured by Schenk in the nervures; and the midrib is "herring-boned." It bears a strong resemblance to *Tæniopteris vittata* (Brongn.) of the Trias (Geikie's 'Text-Book of Geology,' fig. 358); compare also *T. scitamineæ-folia* (Sternberg), from the Stonesfield beds (Phillips's 'Geology of Oxford,' Diagram xxx. fig. 8).

gracilis, *S. Mantelli*, *S. Phillipsii*, *S. Sillimani*, &c., I have been fortunate enough to discover the following North-German forms:—

Pecopteris Geinitzii,
Pecopteris Murchisoni,
Pterophyllum schaumburgense (*Dunker*).

and an undetermined one, which I think is *Sphenopteris Gœpperti*. They all occur in the beds of stone in the Wadhurst Clay, which are locally used for building and road-metal.

MISCELLANEOUS.

On the Significance of the Polar Cells of Insects. By M. Balbiani.

There is now scarcely any one who admits the homology of the polar cells of insects with the bodies designated by the same name, or more frequently by that of *direction-vesicles*, in animals of other classes, especially the Mollusca and Vermes. Notwithstanding their extreme resemblance, it is well known that a capital difference exists between those two kinds of elements: the direction-vesicles disappear without taking any part in the formation of the embryo, while the polar cells persist and penetrate into the ovum in course of development. But authors are not agreed as to the part played by these elements in the phenomena of organogeny. The first observers, MM. Robin (1862) and Weismann (1863), supposed that they penetrated into the blastoderm to become confounded with the cells of that membrane; but they could not ascertain what became of them in the subsequent evolution. Alex. Brandt, in 1878, was no more fortunate than his predecessors. Metschnikoff, in 1866, studying the development of the viviparous larvæ of Cecidomyids (*Miastor*), was led to see in the polar cells the rudiments of the organ in which is produced the living progeny by which these Diptera multiply during a great part of their existence. But this observation of the Russian embryologist has remained completely isolated; and moreover the singularity of the phenomena of reproduction in *Miastor* did not authorize the extension of his conclusions to the other animals of the same class. Consequently the significance of the polar cells has remained in much obscurity, and the last author who has paid attention to the question (Weismann) could say in a recent memoir (1882) that there is no reason for modifying the name under which these bodies are known so long as the part they perform in the formation of the embryo is not placed above all uncertainty.

In an insect reproducing by the normal mode of fecundated and deposited ova (*Chironomus*) I have succeeded in tracing the transformations of the polar cells in the whole series of phases of embryonic development, from the moment of their first appearance up to

hatching, and I have thus been able to determine the precise significance of these elements. I shall not describe the manner in which they are formed in *Chironomus*, the facts having been described in detail by MM. Robin and Weismann; but I am not in agreement with those observers as to the number of polar cells that we meet with in these insects when these bodies are definitively constituted. Weismann makes them as many as twelve; and, according to M. Robin, their number may even rise to sixteen or twenty by the successive divisions of the polar cells originally formed. I have never found more than eight, in the two species at least of *Chironomus* that I have observed.

The group formed by the eight polar cells is still perfectly isolated and visible at the commencement of the formation of the blastoderm, in the space left at the posterior pole by the vitellus when it has attained the maximum of its retraction. In proportion as the blastoderm becomes organized, the vitellus elongates again towards the two extremities of the egg, and presses against the external envelope the aggregation of polar cells, which is soon completely concealed by the blastoderm; but these cells do not become at all confounded with those of this germinal membrane, as has been supposed by the observers to whose opinion I have already referred. In fact we soon see a slight impression of the blastoderm produced at the posterior pole, forming, as it were, a fold of that membrane towards the interior of the egg. This invaginated part, or caudal extremity of the embryo, pushes before it the group of polar cells, which collect into a rounded mass and always adhere loosely to each other, by which means they retain their original spherical form.

By the advance of the invagination this mass comes to be placed between the caudal rudiment and the ventral surface of the egg, surrounded on all sides by the granular substance of the vitellus. After arriving in this position the polar cells do not again quit their relations with the caudal extremity, which they follow in all its positions at the different stages of development. We still find them there when this part has become elongated by ascending along the convex or dorsal side of the egg, so as to touch with its extremity the posterior margin of the head. During this ascending movement the polar mass divides into two equal oval portions, placed somewhat obliquely on each side of the longitudinal axis of the tail. To arrive at a more complete idea of the constitution of these secondary masses, it is necessary to isolate them and to submit them to the action of reagents. We then ascertain that each of them is formed of two spherical cells, flattened at their surface of contact. From this it appears that instead of the original eight polar cells we no longer find more than four, probably in consequence of a fusion, two and two, of the eight preexisting cells. The reagents do not reveal any enveloping membrane around each mass; but they show that its two constituent cells are in course of proliferation, by causing from two to four clear nuclei to appear in the interior of each of them.

At a more advanced period of development the caudal extremity

is brought back, by the contraction of the embryonic band, towards the posterior pole. It is at this moment that the anus and the posterior intestine are formed, by an invagination of the ectoderm at the extremity of the tail. The posterior intestine, as it lengthens, passes between the two polar masses and separates them from each other. Lastly, at the moment of hatching, the larva possessing all its organs well formed, it is easy to appreciate, from the relations and structure of these masses, their significance in the organism. They are situated in the ninth segment of the body, on each side of the digestive tube, at the level of the junction of the posterior with the middle intestine. An epithelial membrane then surrounds each mass and is produced at its two extremities into a slender filament. Finally, in the interior of the mass the nuclei have multiplied. From all these characters it is impossible to mistake that we have to do with the generative organs of the animal. These then, as we hope we have demonstrated, have their origin in the polar cells.

From this mode of development some interesting consequences follow with regard to the general morphology of the reproductive organs. We have first of all their very early formation, preceding that of all the other organs of the embryo, and indeed even that of the embryo itself in its most rudimentary form, the blastoderm. We have then the community of origin, not only of the male and female sexual products, but of these and of the embryo. We may consequently say that the ovule, the spermatozoid, and the embryo have as their common author the fecundated egg; but while the latter is capable of being directly developed, the former two only acquire the aptitude for development by their union in a new fecundation.—*Comptes Rendus*, November 13, 1882, p. 927.

On Turriform Castings of Earthworms in France. By M. E. L. Trouessart.

The author observed in gardens in the neighbourhood of Angers, along with numerous worm-casts of the ordinary shape, a great quantity of tower-like castings, exactly similar in form and size to that figured by Darwin in his book on earthworms, and ascribed by him to an exotic species of *Perichæta* naturalized in the neighbourhood of Nice.

These turriform worm-casts were about 2 or 3 inches in height, and about $1\frac{1}{5}$ inch in mean diameter; some were more regular than indicated by Darwin, but formed in the same manner, of thick coils of an argillo-calcareous material, black at the moment of production, but becoming light yellowish grey in drying. The earthy matter was strongly agglutinated by a mucus, and resists the rain for a considerable time. All the towers were traversed by a cylindrical passage moulded on the body of the worm, and terminated above in a cone at some millimetres from the apex of the tower. In most

cases this passage corresponded to the underground gallery of the worm.

At the close of the rainy period of September all the passages were perfectly free; but after a few dry days they were found to be obstructed by recent castings, no doubt owing to the worm being prevented, by the hardening of the summit of the tower, from pushing through it to deposit the castings outside. A period of rain is therefore necessary for the production of regular towers, which probably serve principally to protect the subterranean galleries from the influx of rain-water, but may also enable the worms to come up and respire, sheltered from wet and at the same time concealed from birds.

As to the species of worm which formed the towers observed by him, M. Trouessart states that at first he supposed that it might also belong to the genus *Perichæta*, several eastern-Asiatic species of which have been naturalized in the south of France and in Algeria. Great numbers of worms were collected near the spots where the turriform castings were abundant; they all proved to be species of *Lumbricus*, principally *L. agricola*, Hoffm., with a few examples of *L. communis*, Hoffm. On two or three occasions the worm was caught in his tower by suddenly pinching the latter when soft. The worms thus captured always belonged to *Lumbricus agricola*; and it was the anterior part of the body that was lodged in the tower.—*Comptes Rendus*, October 23, 1882, p. 739.

On a Fish from the Abysses of the Atlantic (Eurypharynx pelecanoides). By M. L. Vaillant.

In the last expedition of the 'Travailleur' we found off the coast of Morocco, at a depth of 2300 metres, a fish which may be regarded as one of the most singular creatures with which deep-sea dredgings have made us acquainted.

This animal, about 0·47 metre long and 0·02 metre high at the most elevated part, is of an intense deep black colour. The body, the form of which is masked in front by the abnormal mouth, which will be mentioned further on, resembles that of *Macrurus*; it becomes regularly attenuated from about the anterior fourth, the point at which the external branchial orifice is seen, and terminates in a point at the caudal extremity; the anus is situated at the junction of the anterior third with the posterior two thirds of the body.

What gives this fish a very peculiar physiognomy is the arrangement of the jaws and the structure of the mouth, which are even an exaggeration of what Mr. Ayres has described in *Malacosteus niger*. Although the head is short, scarcely 0·03 metre, the jaws and the suspensorium are excessively elongated; the latter did not measure less than 0·095 metre; and from this it results that the articular angle is carried very far back, to a distance from the end of the

muzzle equal to about three and a half times the length of the cephalic portion. This suspensorium, so far as we can ascertain, is composed of only two pieces—a basal piece, the analogue of the temporal, and an external piece, no doubt representing a tympano-jugal. A long slender style constitutes the upper jaw, the situation of which must make us regard it as the intermaxillary, the maxillary being absent, unless we suppose that the two bones are amalgamated. On both jaws one can feel faint dentary granulations; at the extremity of the mandible there are two hooked teeth, 0·002 metre long.

The buccal aperture, in consequence of this arrangement, is enormous, and it leads into a cavity the dimensions of which are still more astonishing. In fact the upper jaw is united to the sides of the head and of the anterior portions of the body by an extensible cutaneous fold, which allows of a considerable separation; further, between the rami of the mandible is stretched an analogous cutaneous membrane, but much more extensible, and which histological examination shows to contain a great quantity of elastic fibres in bundles; it cannot be compared to any thing better than to the well-known pouch of the pelican. In consequence of this separation of the jaws and the extensibility of the membranes, the mouth, with the pharynx, forms in the fresh animal a vast funnel, of which the body of the fish seems to be the narrow continuation. It is presumable that the food collects in this pouch, and is perhaps partly digested there, a fact comparable to what has been indicated in *Chiasmodus niger*, Johnson.

The respiratory apparatus presents a constitution which is at present unique in osseous fishes. We find six pairs of interior branchial clefts, and consequently five branchiæ. Each of the latter is formed by a double series of free lamellæ. The escape of the water takes place on each side through a very small orifice, forming a simple rounded cutaneous perforation situated towards the level of the termination of the bucco-pharyngeal funnel. We find neither hyoidean apparatus nor opercular pieces.

Without entering into the description of the organs contained in the abdominal cavity, it is important to indicate the complete absence of the swimming-bladder.

I propose to designate this fish by the name of *Eurypharynx pelecanoides*. What place is it to occupy in the ichthyological series? This is a very difficult point to settle in the absence of more complete information as to its anatomy, and especially as to the skeleton, which it is impossible to examine in all its details upon a unique individual.

We may say that the fish presents relations with the Anacanthini, with certain Physostomi, such as the Scopelidæ and Stomiatidæ, and also with the Apodes. While it resembles these last in the want of ventral fins and the imperfection of the opercular apparatus, it differs from them too much in its well-developed and absolutely free intermaxillaries to allow it to be placed in the same group. As regards the Scopelidæ and Stomiatidæ, all the known genera in those

families have a very widely open branchial orifice: in the former the intermaxillary alone forms the free border of the upper jaw; in the latter the maxillary forms part of it; and thus it would be the Scopelidæ that *Eurypharynx* would approach, especially as it does not present the hyoidean barbel which has hitherto been indicated as characteristic of the Stomiatidæ. However, of all fishes it is to *Malacosteus niger*, Ayres, placed in the latter family by zoologists, that we are tempted to approximate the animal here under considertion; they alone present the simple arrangement of the suspensorium indicated above. But, finally, it is perhaps with the Anacanthini that its relations seem to be most real, whether we consider the form of the body, which greatly resembles that of *Macrurus*, or the absence of ventral fins, which is usual in certain animals of the group; thus several Ophidiidæ and all the Lycodidæ (the latter even having their branchial orifice reduced, although not to the degree that occurs in our animal) increase the probability attaching to this view. However, the characters of *Eurypharynx* are so strongly marked that in any case it is necessary to regard it as the type of a new family: and of this it would be the sole representative, unless subsequent investigations show that we must unite with it the genus *Malacosteus*.—*Comptes Rendus*, December 11, 1882, p. 1226.

The Suctociliata, *a new Group of Infusoria, intermediate between the* Ciliata *and the* Acinetina. By M. C. de Mereschkowsky.

Constant and very well-marked characters separate the ciliated Infusoria from the Acinetina; the former are clearly distinguished by the presence of vibratile cilia from the latter, which never present them, at any rate in the adult state, and which, on the other hand, always possess special organs known by the name of *suckers*.

Hitherto no intermediate form has been indicated as forming the passage between these two very distinct and well-marked groups. The sole character that approximates the ciliated Infusoria to the Acinetina and establishes a relationship between the two groups consists in the fact that the Acinetina in certain stages of their development, like the Infusoria Ciliata, present cilia, which, however, soon disappear.

While studying the Protozoan fauna of the Bay of Naples during last summer, I met with a form intermediate between the two groups, presenting at the same time the cilia of the ciliated Infusoria and the suckers of the Acinetina. This new type comes in luckily to fill up the gap existing between the two groups already recognized, and serve, in its quality of an intermediate form, to establish their genealogy.

The Infusorian that I desire to make known is one of the commonest in the Bay. At the first glance it might be taken for a Halterine, to which it presents some resemblances in organization.

In size it does not exceed a small *Halteria*; its body, which is rounded and somewhat pyriform, terminates anteriorly in a slightly developed conical neck, at the extremity of which there is an aperture. The body is clothed with a thick cuticular membrane, especially at the posterior extremity; and this presents spirally arranged longitudinal folds. This membrane, by its resistancy, determines the general form of the body. The neck, covered with a thin cuticle, is alone contractile; at the will of the animal it can invaginate itself in the interior, and thus become elongated and shortened. However, in its state of greatest extension it never exceeds the length of the body.

At the base of the neck there is a collar of long cilia, by means of which the animal can execute two kinds of movements. One kind consists of slow movements, as if the animal were creeping over various objects; the others are sudden leaps, so rapid that it is impossible to follow the Infusorian. The cilia are about as long as the body, stout, rigid, and arranged in three circles placed one above the other; the cilia of the middle circle are perpendicular to the long axis of the animal; those of the other two circles are directed obliquely, those of the anterior circle towards the anterior extremity, and those of the posterior circle towards the posterior extremity. Each circle contains seven or eight cilia, so that the entire collar consists of from twenty-one to twenty-four.

The granular and colourless protoplasm encloses a rounded or slightly oval nucleus, situated at the middle of the body, and a contractile vacuole placed at the posterior extremity.

The most interesting point in the organization of this animal is the constant presence of four suckers, arranged symmetrically upon the margin of the orifice of the neck. They are very short, not attaining even the length of the neck: as to their structure, it is the same as that of the suckers of the Acinetina; we distinguish in them a slender peduncle, terminated at the extremity by a globular enlargement. When the neck becomes invaginated, the four suckers are likewise carried into the interior, and cannot then be observed. It is this position that the animal usually presents, and it is then easily mistaken for a ciliated Infusorian.

When it traverses the field of the microscope by sudden leaps, it always presents this aspect; often it even retains the same appearance immediately after stopping; but when it is observed for a certain length of time we see the neck become devaginated, and the four suckers make their appearance. When startled by a shock, if the Infusorian wishes to leap, it passes them again into the interior. Sometimes the animal fixes itself, by means of its suckers, to various objects; or it may creep slowly by the aid of its cilia, with the mouth open and the suckers directed forward.

The Infusorian, the organization of which I have just described in some detail, was detected long ago by a German naturalist, M. Cohn, who has given a very superficial description of it under the name of *Acarella siro*. The essential character of the presence of the four

suckers, as well as several other characters, escaped him; and this led him to place his Infusorian among the Ciliata.

But, as we see, by certain characters it is a ciliated Infusorian, and by others an Acinetine; it is therefore necessary to form for it, at least, a distinct family, which we propose to name Suctociliatæ. This family may be arbitrarily arranged in either of the orders as an intermediate form; or, if it be preferred, we may make of it the new order Suctociliata.

It remains to be learned whether the Suctociliata are not ancient primitive forms which may have given origin, on the one hand, to the Ciliata, by the disappearance of the suckers; and, on the other, to the Acinetina, by the suppression of the vibratile cilia; or, indeed, should we not rather regard *Acarella siro* as a Ciliate which has acquired suckers without having any genealogical relations with the Acinetina? or, lastly, as an Acinetine which may have retained its embryonic cilia until its adult age? We cannot choose any one of these three suppositions as being the most probable, all three of them having considerations in their favour. The developmental history of the Infusorian, which is very difficult to study on account of its rapid movements, can alone decide the matter with certainty. The last of the suppositions, however, seems to us the least probable. —*Comptes Rendus*, December 11, 1882, p. 1232.

A new Fossil Orthopterous Insect from the Coal-measures of Commentry, Allier. By M. Charles Brongniart.

Until the present year only 110 species of insects were known from the Carboniferous rocks of the whole world. In France none were known until 1877, when the author received from M. Grand'Eury some wings of Blattidæ from St. Etienne; and in the same year M. Fayol sent him from Commentry a Phasmian, described under the name of *Protophasma Dumasii*. Since that date, at least 430 impressions have been obtained from the Coal-measures of Commentry; these include 300 Blattidæ and 130 insects of various orders.

From M. Fayol the author has just received a remarkable Orthopteron of gigantic size, found by M. Bellard in fine blackish shales at Commentry. All parts of the body, except the upper part of the thorax and abdomen, are preserved. It approaches the Phasmidæ most closely; and it is to that group that the author refers it as forming a new genus, under the name of *Titanophasma Fayoli*.

The genus *Titanophasma* comes nearest to *Protophasma* among fossil forms; among recent types it resembles *Phibalosoma* in size and the general form of the body, and in the presence of numerous spines and warts upon its legs. In the length of the prothorax *Protophasma* differed from the existing Phasmidæ; in this respect *Titanophasma* differs from *Protophasma*, and approaches the existing

species, having the prothorax rather shorter than the other divisions of the thorax. The body is stout, the legs robust, and the joints of the tarsi, five in number, are of nearly equal size. In living Phasmidæ the first joint is longer than the rest. Another character separating the new fossil from the recent forms is that the fore limbs are shorter than those of the second and third pairs. There are appendages at the extremity of the abdomen, as in the Phasmidæ of the present day.

Titanophasma Fayoli, C. Brongniart.—The species measures 0·25 metre in length. In the specimen the insect is lying upon one side, and the thorax and abdomen are uninjured only at the lower part. The head shows a large oval eye, but not very distinctly; part of the mandible is armed with strong denticulations. The antennæ are inserted in the middle of the forehead, short and slender; they measure 0·035 metre, are nearly cylindrical, with the joints nearest the head longer and broader. The joints are not sufficiently distinct to be counted; but there seem to be about twenty. The thorax appears to be warty or spiny. The prothorax is 0·02 metre high close to the head, and presents, as in *Protophasma*, a sort of spiny collar; the mesothorax and metathorax are longer than the prothorax, as appears from the relative positions of the legs.

The abdomen is 0·18 metre long, with eight segments of nearly equal length; the last is shorter and terminated by two falciform appendages, of which the extremity cannot be seen. On the lower surface of each segment there are two spinous lines, which, on the first and last segments, separate from one another and ascend towards the upper part.

In the legs the coxa is strong and presents several rows of spines; and the other parts of the legs are covered with numerous fine spines, generally arranged in four or six parallel or anastomosing lines, between which are observed two kinds of large tubercles. The insect was probably apterous, like the females of *Phibalosoma*. The author remarks, in conclusion, that in general the insects of the Coal-period differ but little from those of the same groups in the present epoch, and that they were already very highly organized. —*Comptes Rendus*, December 11, 1882, p. 1228.

Sexual Characters in Cephalotaxus.

Mr. Meehan exhibited some fruit of *Cephalotaxus Fortunii*, a Chinese tree, this plant growing on the grounds of P. J. Berckmans, at Augusta, Georgia. This tree had for many years produced male flowers only. During 1882 it produced abundance of fruit. It showed that the genus was not truly diœcious; and, further, it afforded an illustration, now not uncommon, that trees a long time of one sex only would sometimes change to another. Sex is not an invariable characteristic in an individual tree.—*Proc. Acad. Nat. Sci. Philad.*, Oct. 17, 1882, p. 252.

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XI.—*Anatomy and Physiology of* Hæmatopinus tenuirostris, *Burm.* By OSCAR STRÖBELT*.

[Plate III.]

It is only of late that some considerable attention has begun to be paid to the Pediculina. Among the more important works upon this group of animals we must here mention those of Denny (10)†, Giebel (13), and Piaget (15). The last-

* Inaugural-Dissertation zur Erlangung der Doctorwurde einer hohen philosophischen Facultat der koniglichen Akademie zu Munster. Dusseldorf, 1882. Translated by W. S. Dallas, F.L.S.

† The numbers in parentheses refer to the works of which the titles are given below:—

1. LINNÉ, C. Fauna Suecica. Holmiæ, 1761.
2. LINNÉ, C. Systema Naturæ. Vindobonæ, 1770.
3. FABRICIUS, J. C. Systema Entomologiæ. Flensburgi, 1775.
4. BERKENHOUT, JOHN. Synopsis of the Natural History of Great Britain and Ireland. London, 1789.
5. TURTON, W. A General System of Nature. London, 1806.
6. STEWART, C. Elements of the Natural History of the Animal Kingdom. London, 1817.
7. NITZSCH, C. L. "Die Familien und Gattungen der Thierinsekten (Insecta epizoica)," Germar's Magazin der Entomologie, Band iii Halle, 1818.
8. STEPHENS, J. F. A Systematic Catalogue of British Insects. London, 1829.
9. BURMEISTER, H. "Handbuch der Entomologie," Band ii Abth 1 & 2. Berlin, 1835 and 1838.

named naturalist especially, by the exact descriptions and correct and elegant figures in his classical work, has gained great credit in connexion with these animals, which have hitherto been under the ban of a deeply-rooted aversion, and therefore have long been neglected. It is to him that we are by no means least indebted for the present extent of our knowledge of the Lice, of which far more than a thousand species are known.

But however much our knowledge of the external form of these animals has been advanced by the labours of the abovementioned and many other naturalists, little attention has hitherto been paid to their internal anatomy. Upon the anatomical structure of the Pediculina information has been given by Swammerdam (16) among the older writers, and by a few more recent ones, such as Simon (17), Landois (23–25), and

10. DENNY, H. Monographia Anoplurorum Britanniæ, or an Essay on the British Species of Parasitic Insects belonging to the Order Anoplura of Leach. London, 1842.
11. GURLT, E. F. "Ueber die auf den Haussäugethieren und Hausvögeln lebenden Schmarotzer-Insekten und Arachniden. Zweiter Aufsatz," Magazin für die gesammte Thierheilkunde, Jahrg. ix. Berlin, 1843.
12. SIMONDS. Journal of Agricultural Science, ser. 2, vol. i.
13. GIEBEL, C. G. Insecta Epizoa, die auf Säugethieren und Vögeln schmarotzenden Insekten nach C. L. Nitzsch's Nachlass bearbeitet. Leipzig, 1874.
14. TASCHENBERG, E. L. Praktische Insektenkunde. Band v. Die Schnabelkerfe. Bremen, 1880.
15. PIAGET, E. Les Pédiculines: Essai monographique. Leyden, 1880.

16. SWAMMERDAM. Bibel der Natur. 1752.
17. SIMON, G. Hautkrankheiten. 1851.
18. LEUCKART, R. "Ueber die Micropyle und den feineren Bau der Schalenhaut bei den Insekteneiern," Muller's Archiv, 1855.
19. LEYDIG, F. "Zum feineren Bau der Arthropoden," Muller's Archiv, 1855.
20. LANDOIS, H. De systemate nervorum transversorum in septem Insectorum ordinibus. Gryphiswaldiæ, 1863.
21. GRIMM, O. von. "Zur Embryologie von *Phthirius pubis*," Bull. Acad. Imp. de St. Pétersb. tome xiv.
22. MURRAY, A. On the *Pediculi* infesting the different Races of Men. Edinburgh, 1864.
23. LANDOIS, L. "Anatomie des *Phthirius inguinalis*," Zeitschr. für wiss. Zool. Bd. xiv. 1864.
24. ——. "Anatomie des *Pediculus vestimenti*," ibid. Bd. xv. 1864.
25. ——. "Zur Anatomie des *Pediculus capitis*," ibid. Bd. xv. 1865.
26. GRABER, V. "Anatomisch-physiologische Studien uber *Phthirius inguinalis*," Zeitschr. fur wiss. Zool. Bd. xxiii.
27. DARWIN, C. Die Abstammung des Menschen. Deutsche Ausgabe, von Victor Carus. Stuttgart, 1875.
28. KRANCHER, O. "Der Bau der Stigmen bei den Insekten," Zeitschr. fur wiss. Zool. Bd. xxxv. 1881.

Graber (26); but all these have treated only of the lice parasitic upon man.

With the purpose of filling up this gap in our literature, which, with the lapse of time, is becoming very sensible, and at the suggestion of my honoured teacher, Prof. H. Landois, I made the internal anatomy of the Pediculina, and especially of those which live upon our domestic mammals, the objects of a special study; and in the present work I communicate the results which have come from my investigations on the *Hæmatopinus tenuirostris*, Burm., parasitic on *Bos taurus*.

But before I proceed to the exposition of these, I may be permitted to preface them with something upon the history of this louse.

Historical.

We know at present three Pediculina which live upon the domestic ox (*Bos taurus*, Linn.)—namely, *Trichodectes scalaris*, Nitzsch, *Hæmatopinus eurysternus*, Nitzsch, and *H. tenuirostris*, Burm. Whilst authors agree in the description of the first two species, singularly enough the existence of the last-named species has had doubt cast upon it by Piaget. In his great work he says *, "Since Linné, authors speak of a second species of *Hæmatopinus* likewise living upon *Bos taurus*. Notwithstanding my researches, I have not succeeded in meeting with this species, and some doubts have arisen involuntarily in my mind." In support of his doubts he relies upon the defective descriptions and the inaccurate figures of different authors.

As regards the father of scientific classification, Linné, in the first place, he cites two species as living upon *Bos taurus*:—

"1. *Pediculus Tauri* Bovis: abdomine lineis transversis octo ferrugineis.

"Suecis Koe-luus.

"Habitat in Vaccis; hæc minor est species, datur et altera, quæ major et insequens.

"*Descr.* Totus albus, minimus. Caput testaceum. Pedes testacei, apice albidiores. Abdomen album, lineis octo testaceis transversis in dorso; quinque fasciis transversis in ventre; quæ omnes lineæ non tangunt marginem seu latera; latera tamen obscuriora reliquo corpore sive punctis octo ferrugineis notata."

This is undoubtedly, and according to the concurrent opinions of authors, our present *Trichodectes scalaris*, N.

* *Loc. cit.* p. 650.

Linné mentions as a second species:—

"2. *Pediculus Vituli* Bovis: abdomine plumbeo.

"Suecis Blaluus.

"Habitat in Bobus.

"*Descr.* Præcedenti maior: abdomine ventricoso, acuminato, cæruleo-fusco; pedibus brevibus, crassis, griseis, ut et capite et thorace griseis."

The question now is, whether this *Pediculus vituli*, Linn., is identical with *Hæmatopinus eurysternus*, N., or with *H. tenuirostris*, Burm.

Piaget says, "Linné does not cite the other species, the *eurysternus*, and seems to have been acquainted only with the *vituli*;" but this statement can by no means serve in support of his doubts as to the existence or specific right of *Hæmatopinus tenuirostris*. Linné actually knew only this one species; but whether it is *H. eurysternus* or *tenuirostris* must be ascertained by the comparison of the animals with his description. All other authors agree in regarding *Pediculus vituli*, Linn., and *Hæmatopinus tenuirostris*, Burm., as one and the same species. Once, indeed, Nitzsch* seems inclined to identify *Pediculus vituli*, Linn., with his *P.* (*Hæm.*) *eurysternus*, as appears from the query, "An huc *Ped. vituli*, Linn?" Linné's description is certainly any thing but exact; but from the words "Abdomine cæruleo-fusco, et capite et thorace griseis," it appears clearly and distinctly that *P. vituli*, Linn., is identical only with *Hæmatopinus tenuirostris*, Burm.

Piaget says further, "Denny and Giebel rarely give sexual differences; it may be that they have described the female of *eurysternus*, without paying any attention to the male. Now this male, which is much narrower, has the head somewhat pointed, and appears to me to be their *tenuirostris*. Must we then admit two different species? Denny had seen only two individuals (♀ or ♂?) obtained from a calf; he never found any on *Bos taurus*. Giebel, however, declares it to be very common, very widely distributed."

Piaget may be perfectly right in saying that Denny and Giebel do not frequently indicate sexual differences; but that both of them have taken the male of *H. eurysternus* for the species *tenuirostris* described by them is, from their descriptions and figures, quite inadmissible. Although, as I readily agree with Piaget, these two authors have certainly not endeavoured too strenuously to attain accuracy in their figures, the difference in the figures is too great to allow us to suppose that the two species are identical. From the figures, defec-

* Germar's Magazin, Bd iii. p. 305.

tive as they may be, we at once see that we have to do with two separate species. Leaving all other characters out of consideration, this is shown at the first glance by the great difference of the head and thorax in the case of both authors*.

But however different the male and female of *H. eurysternus* may be, we find, if we compare the two species (*H. eurysternus* and *H. tenuirostris*), even without magnifying, that they are typically distinct, and that there can be no ground for the assumption that we have to do with the male and female of the same animal.

Piaget takes as a further ground for doubt Denny's statement that he had only seen two individuals of this species, which were obtained from a calf, whilst Giebel asserts that the species lives very commonly upon the domestic ox and is very widely distributed. Denny says†:—"The only two examples of this species which I have examined were kindly forwarded to me by Rev. L. Jenyns, who found them upon a calf. Mr. J. named them *vituli*; and I have no doubt they are the species so named by Linnæus and Fabricius. It may appear somewhat strange that a young animal should have a distinct species of parasite which is not found upon its parents; but, as far as we are able to judge, such is the fact. I have examined numbers of the lice from oxen, but never detected a single specimen of this species amongst them, though there were of *Trichodectes scalaris*, which lives upon cattle and in society with the *H. eurysternus*." Notwithstanding his endeavours, therefore, he could never find the species upon *Bos taurus*. Giebel, on the contrary, says it is very common and widely distributed. Piaget stumbles over this apparent contradiction; and yet both statements may very well be true.

I have not been much more fortunate than Denny. I have only once found *H. tenuirostris* upon an ox, which came from Hamburg; but in this case it was in great numbers. Subsequently I have never succeeded in procuring this species in the neighbourhood of Münster, but always obtained only *H. eurysternus* and *Trichodectes scalaris*. This circumstance may be explained in two ways: either *H. tenuirostris* is parasitic upon our *Bos taurus*, and we have only not found it hitherto, or the animal is confined to a particular district and perhaps to a particular race. Nitzsch and Giebel obtained their lice from the environs of Halle, while Denny collected in England, and Piaget in Holland. Unfortunately we have no precise observations upon either species. It would certainly

* See Denny, pl. xxv. figs. 5 & 3; and Giebel, Taf. ii. figs. 8 & 9.

† *Loc. cit.* p. 32.

be not uninteresting, and indeed of great importance, with respect to the opinions of Lamarck and Darwin, to ascertain more precisely the regions of distribution of the two species and their boundaries. Thus, in Darwin's great work on the Descent of Man, he says*:—"In determining whether the varieties of the same kind of domestic animal should be ranked as specifically distinct, that is, whether any of them are descended from distinct wild species, every naturalist would lay much stress on the fact, if established, of their external parasites being specifically distinct. All the more stress would be laid on this fact, as it would be an exceptional one; for I am informed by Mr. Denny that the different kinds of dogs, fowls, and pigeons, in England are infested by the same species of Pediculi or Lice."

A. Murray (22) has investigated the Pediculina collected in different countries from the different races of men, and found considerable differences both in their colour and in the structure of the buccal organs and limbs. How much more important would it be if it were found that different species occur upon different races. We know, indeed, only that different lice are parasitic upon cattle &c.; but in collecting these no one has yet taken the trouble to note the race of the host in each case. It is only when this has been done in numerous cases that fertile conclusions may be drawn from these observations.

After this digression, let us go back to Piaget. He says further (p. 650), "Gurlt figures two species as very distinct, especially in the form of the head, and in the transverse spot of the penultimate segment; but he nowhere gives the sexual differences, which would be decisive."

That Gurlt's figures (11) are very different is easily seen; but they have been drawn so much in miniature that we cannot get very much more out of them. And as regards the non-statement of sexual differences, we need not wonder at this in Gurlt's case; for we do not find such differences noted even by Denny, from whom Gurlt generally translates pretty literally.

From what has been said it would appear that Piaget had no grounds for casting doubt upon the existence or the specific distinctness of *Hæmatopinus tenuirostris*. That we have really to do here with two perfectly different species is sufficiently shown by my figures (1, 2) on Plate III., which I have made from individuals lying before me; and in connexion with this it must be particularly noticed that I possess males and females of both species.

* Vol. i. p. 210.

Thus Piaget's doubts are got rid of. It remains only to examine into a remark of Giebel's. "If Denny's figure is accurate," says he *, "this species is variable; for it [the figure] represents the head less pointed, the thorax longer, the first pair of legs much stronger, and the abdomen less perfectly spindle-shaped than is the case in our specimens." These differences undoubtedly exist in the figure; and to this must be added that Giebel figures *ten* abdominal segments, while Denny represents only *eight*. Nevertheless I am of opinion that we have not to do here with a variable species, but that, by the inaccuracy of both the figures, the dissimilarity has been made to appear greater. If we were to assume, from the figures, that this species varies, we must do the same with many other species which have shared the fate of *Hæmatopinus tenuirostris* in the matter of figuring.

Place in the System, Name, Occurrence, Remedies.

As regards the systematic position of *Hæmatopinus tenuirostris* we may speak briefly as follows:—*H. tenuirostris* belongs to the genus *Hæmatopinus*, established by Leach, and now containing about twenty species, which, again, is referred to the great family of the Pediculidæ or true Lice. The following Table, derived from Piaget †, may serve to characterize its position in the family Pediculidæ:—

Pediculidæ.

1.	Antennæ with 5 joints	3.
	Antennæ with less than 5 joints	2.
2.	Antennæ three-jointed	*Pedicinus*, Gerv.
	Antennæ four-jointed	*Echinophthirius*, Gerv.
3.	Legs with two unequal claws; head cylindrical (tubular)..........................	*Hæmatomyzus*, Piag.
	Legs with one claw; head rounded or longish.	4.
4.	Abdomen with 6 segments with lateral dilatations. Its second segment with 3 closely approximated stigmata	*Phthirius*, Leach.
	Abdomen with 7–9 segments, with or without lateral dilatations. Second segment with a single stigma	5.
5.	Head narrowed into a neck before its insertion into the thorax. Abdomen with 7–8 segments. Tibia with a distinct thumb	*Pediculus*, Leach.
	Head narrowed insensibly into the thorax. Abdomen with 8–9 segments. Tibia simply elevated at the inner angle...............	*Hæmatopinus*, Leach.

All the species of the genus *Hæmatopinus* are parasitic upon mammals.

* 13, p. 43. † *Loc. cit.* p. 618.

As to the specific name Giebel says, "With regard to the name, Denny has adopted the Linnean name, while Burmeister has transformed Nitzsch's Greek name (*oxyrhynchus*) into Latin. As it is certainly inadmissible to name this parasite after its host, Burmeister's denomination, as published before Nitzsch's, must be regarded as having the first right." Burmeister was certainly in the wrong to convert Nitzsch's Greek name into the Latin one, as he ought to have preserved the right of priority for Nitzsch; on the other hand, however, he published his name first, and this name has since taken its place in literature, so that it does not seem advisable to change it again.

The Sharp-headed Ox-louse lives on the neck and head of cattle. It is very sluggish, and moves but rarely from its place; it usually remains quite quiet, with its proboscis buried in the skin, so that it requires some effort to remove it from the ox. Its eggs it deposits near the base of the hairs of its host. They are always attached so that the micropylar apparatus is turned towards the tip of the hair. Moreover there is generally only one nit upon a hair, rarely two, and these attached at some distance from each other. Only once I found three upon one hair, placed immediately over one another, and in different stages of development. It is principally upon badly nourished and young animals that these lice are parasitic. I must not pass without notice the fact that, as in the case of very many lice of the family Pediculidæ, the number of females is considerably in excess of that of the males. Thus among about one hundred females I found only seven males.

The best means of keeping away these visitors, which are so unwelcome to the farmer, are undoubtedly cleanliness, careful currying, and good feeding. But if the parasites make their appearance they may be got rid of, according to Taschenberg (14, p. 102), by combing the infested animals with a close-toothed comb, by washing with a mixture of soap, benzine, and water, or with a decoction of *semen staphysagriæ*, or tobacco in water, by rubbing in Persian insect-powder or grey mercurial ointment, and other remedies. Quite recently Falkenberg's chemical factory at Grünau, near Berlin, has advertised "Parasite neck-rings," by wearing which "any animal may with certainty and without danger be freed from parasites (lice, fleas, &c.) within twenty-four hours, and preserved in a clean state." Nevertheless I cannot help having some little doubt as to the efficacy of this last-named remedy.

Hæmatopinus tenuirostris, Burm.

(*Pediculus vituli*, Linné; *Hæmatopinus vituli*, Stephens and Denny; *Pediculus oxyrhynchus*, Nitzsch; *Pediculus tenuirostris*, Burmeister.)

External Anatomy.

Hæmatopinus tenuirostris, or the Sharp-headed Ox-louse, has a rather elongated and elegant shape (Pl. III. fig. 1). Its colour throughout is a shining brown, "chestnut and shining" as Denny (10, p. 31) correctly calls it, passing into dark brown in the claws. The head and thorax show a light grey tinge, while the abdomen presents a tint which it is difficult to describe, indicated by Linné (1, p. 476) as "cæruleo-fusco," by Giebel (13, p. 43) as "dirty bluish violet." This shimmer is due to the stomach shining through, and varies according to its degree of fulness. Like all the species of the genus *Hæmatopinus*, our animal presents a body distinctly divided into head, thorax, and abdomen.

The head is longish oval. The antennæ, which are articulated to the sides of the head about the middle, divide it into two parts. The anterior, the forehead (*frons*) has a length of 0·214 millim.* Its sides, which are gently curved, converge to a point from the antennæ. At the apex the sheath of the rostrum, 0·027 millim. long, projects as an obtuse process. The hinder part, measuring 0·261 millim. in length, diminishes scarcely perceptibly behind the antennæ, then becomes somewhat wider, and thence to the thorax shows nearly parallel temporal margins, so that the middle head (*syncipit*), or the part of the head situated between the temples (*tempora*), appears nearly rectangular. The hind head (*occiput*) penetrates like a wedge into the thorax. The notch on each side at that part of the head where the antennæ are seated (*excisura* or *sinus orbitalis*, or *orbita*) is very small. The head has its greatest breadth, 0·256 millim., a little behind the antennæ; between the antennæ its greatest breadth is 0·203, and in front of them 0·163 millim. In the anterior part of the head are situated the buccal organs, in its hinder part the cerebral ganglion and the very small and not easily perceptible eyes, the position of which, however, is always indicated by a weak bristle placed immediately above them. The whole head is traversed from before backward by the œsophagus and the tracheæ of the head. The antennæ

* The measurements are always taken from the mean, and relate, where not otherwise stated, to the ♀, as the more abundant.

(fig. 7), which are articulated in front of the eyes as already mentioned, consist of five joints (*antennæ præoculares, quinquearticulatæ*); they attain about half the length of the head. At the articulation the first joint is 0·073 millim. in width; the last joint has a breadth of 0·035 millim.; the lengths of the individual joints are as follows:—first joint 0·062, second 0·064, third 0·048, fourth 0·045, and fifth 0·032; total 0·251 millim.

All the five joints are beset with hairs, the length of which shows great differences in the same antenna, while their position seems to be constant in different individuals. The fifth or terminal joint has its apical surface sharply marked and oblique (fig. 7); and from it rise some small peculiar bacilli with rounded ends. There are also on the different joints variously formed chitinous plates and thickenings of the epidermis.

The eye, as in all lice, is simple. It consists of a strongly convex cornea; behind this we find a clear layer, which appears like a number of closely approximated vesicles with gelatinous contents. Immediately behind this follows a reddish-brown pigment-layer. Nothing could be seen of any lens. The size of the eye is about 0·048 millim., and its distance from the sheath [of the rostrum] about 0·305 millim. As regards the position of the hairs on the head, as also upon the rest of the body, the figure (fig. 1) will furnish information.

The thorax is quadrangular, with rounded anterior angles, rather broader than long, and considerably broader than the head (0·329 millim.). The pro-, meso-, and metathorax are closely amalgamated, so that it is impossible to determine their boundaries. On both sides of the thorax, towards the ventral surface, are the sockets (*acetabula*) in which the legs are articulated. These sockets are oval; and in the first two on each side their longer axis is perpendicular to the median line of the whole animal, while in the hinder ones on each side it forms an angle of about 60°. All the three acetabula are united by a chitinous thickening with the chitinous band which, on the underside, runs in a curve on each side from the middle of the thorax to the anterior angles. The first socket is smaller than the other two, just as the anterior pair of legs is also considerably inferior in thickness to the two hinder pairs (fig. 1). The thorax has further, on each side, turned towards the ventral surface, a stigma, placed at the level of the middle pair of legs, and therefore, as in all the species of the genus *Hæmatopinus* which have been investigated, belonging to the mesothorax, while in the genera

Phthirius and *Pediculus* the thoracic stigma is to be referred to the prothorax.

The legs are all constructed upon the same type. The *coxa* is freely movable in the acetabulum, and is a stout joint furnished with powerful muscles (fig. 6, *c*). This is followed by the *trochanter* (fig. 6, *tr*), which is not half so large and not very muscular. Freely movable upon this, next comes the large *femur*, bearing at its extremity the powerfully-developed *tibia* (fig. 6, *f* and *ti*). The latter has not, as in the other lice, a chitinous process directed forwards, but is simply elevated at the inner angle (fig. 6, *e*). At this point, however, the chitinous skin shows a slight thickening, behind which the tibia appears to be excavated. The above-mentioned elevation of the tibia at the inner angle is more considerable on the hinder pairs of legs, reduced to a minimum on the first pair (fig. 1). Moreover the legs of the first pair have a scarcely perceptible chitinous thickening at this point. On all the pairs of legs, however, this process bears a number of hairs. The *tarsus*, which follows the tibia, is two-jointed, the first joint considerably narrower than the tibia, and only about half its length. The second joint consists of a somewhat curved claw, which is narrow and light-coloured and terminated in a point on the first pair of legs, in the other two pairs broad, dark brown, and rounded at the end (fig. 6, *ta*, *k*, and fig. 1).

The abdomen is separated by a distinct furrow from the thorax, and consists of nine segments, which, however, externally are marked off from each other very faintly by indentations. Neither Denny nor Giebel give the number of the abdominal segments; but Denny (10, pl. xxv. fig. 8) figures *eight* of them, having evidently overlooked the ninth, very small segment, while Giebel (13, Taf. ii. fig. 9) represents *ten* segments, the first of which must be referred to the thorax. It is certainly the case that by mere external examination one may very easily be in doubt whether eight or nine segments are present; but the preparation of the muscles (*musculi transversales*) at once shows that the number of segments is nine. The first segment, as also the eighth and ninth, bear no stigmata; the other six have each one on each side, slightly turned towards the ventral surface. The hairiness is in general short and scanty; on the abdomen the hairs are scattered irregularly, and it is only in the vicinity of the stigmata that some regularity appears. Thus beneath each stigma there stand *two* hairs, which, in the case of the first three on each side, do not exceed the other hairs in length, but in that of the three hinder ones attain twice or

three times this length. In the male the terminal segment is blunt, while in the female it is produced on each side into a process which is closely covered with hairs. Between these processes the margin of the segment is straight. From the middle of this straight termination the longitudinally cleft genital fissure extends forward. The two abdominal processes are united by a chitinous ring which bears a number of shorter and longer hairs directed towards the genital orifice. If we make a longitudinal section through the abdomen, so as to divide it into a right and a left half, we see how the last segment seems to be excavated. The epidermis is firm and thick-scaled on both the dorsal and ventral surfaces.

Internal Anatomy and Physiology.

Integument.

Hæmatopinus tenuirostris has a yellowish, translucent, tolerably firm external chitinous envelope, which shows two layers —an outer one, the *epidermis*, and an inner one, the *cutis.*

The *epidermis* shows a different structure at different parts of the body. Thus on the middle part of the back it appears to consist of small rounded scales, pretty regularly arranged in series, lying one over the other like the slates on a roof. Towards the abdominal extremity these little scales gradually become quadrangular, with the sides much curved, and are separated from each other by double-contoured grooves. Thence to the end of the abdomen we see small, triangular, imbricated scutes, which not unfrequently run out into a point. While on the dorsal surface a certain regularity appears in the arrangement of the scales and scutes, on the ventral surface the epidermis is divided by much curved and contorted furrows into multiform irregular sections, which give the whole an exceedingly varied and elegant appearance. The integument of the head is cut up by double-contoured furrows into divisions of very different forms, but which always more or less resemble hexagons, and may be referred to that form. On the other hand, the epidermis of the limbs and antennæ shows no such divisions, but is simple. Besides the elegant furrows, many thickenings are to be observed in the integument. Thus on the dorsal surface a broad thick band passes forward from the middle of the hinder margin of the thorax, divides at about the middle of the thorax, and runs up parallel to the margins of the occiput. Further, the bands which run from the acetabula to the thickening just described, as well as the acetabula themselves, are thickenings of the

epidermis. The legs also show many thickenings of the epidermis, especially in their last two joints. All these thickenings have a dark brown colour. The structure of the epidermis is most peculiar on the antennæ. In general the integument here shows no divisions; but it appears somewhat lighter, which indicates a less firm consistence. But each joint of the antennæ is furnished with two or more chitinous plates. These are thick, firm, and placed parallel to the long axis of the antenna. Their form is different in the different joints. The first and second joints have bacilliform, and the third uncinate plates; the plates of each pair are always united by a somewhat darker chitinous layer (fig. 7). In the fourth and fifth joints the structures in question are particularly noteworthy. In the fourth joint we find two uncinate plates, one of which, however, is surrounded (fig. 7 *c*) by a lighter chitinous pad. The latter, in turn, shows a small circular excentrically placed opening. Below the pad there is another almost rectangular thickening of the outer chitinous layer. The fifth joint has a similar armature symmetrically placed. Here there is, on one side only, a triangular plate; and at the same level with this on the other side there lies a quadrangular chitinous plate, and beneath this a rounded slightly bordered chitinous piece (fig. 7 *d*), showing a small rounded opening near its middle. What purpose these openings serve, whether they lead to the organs of hearing or of smell, could not be ascertained. This, however, is certain: they are connected with the nervous system, as is shown by the course of the two nervous filaments which I was able to trace distinctly to the end of the fifth joint.

Beneath the epidermis lies the *cutis*, a somewhat darker structureless layer of about the same thickness as the epidermis, as is distinctly shown by transverse sections and the abdominal processes of the female.

The *hairs* have still to be mentioned as special structures of the integument. As already stated, these vary considerably in length. They are all of a pale yellow colour, present exactly the same structure, and, like the hairs of the Arthropoda generally, are homogeneous. In the interior they have a cavity which is produced in the form of a tube through epidermis and cutis, and thus connects them with the body-cavity and the nutritive organs.

Quite different from these hairs are the structures which arise from the terminal surface of the fifth joint of the antennæ. These constitute small round-ended bacilli, without any recognizable internal cavity or special structure. I count five upon each antenna (fig. 7 *b*). I could not hesitate a moment

to recognize them as organs of the sense of touch, especially as one of the nerves penetrating into the antennæ can be distinctly traced to them. The name of "tactile papillæ" or "tactile bacilli" therefore appears to me to be very appropriate for them.

Organs of Digestion.

The digestive apparatus (*tractus intestinalis*) comprises the following organs:—the buccal organs, the œsophagus, the stomach, the small intestine, the large intestine or colon, and, further, the Malpighian vessels and the salivary glands.

The *buccal organs* of *Hæmatopinus tenuirostris* are placed in the fore part of the head, not quite in the middle, but approximated to the ventral surface. The fore part of the head has an indentation of the temporal margins before the apex (fig. 8), then becomes a little enlarged, and is produced in front into a fine tube, which shows a small emargination on the ventral side. Out of this tube or "sheath" (*proboscis*) there can be protruded a sucking-rostrum, which attains half the length of the head, and, according to Giebel (13, p. 43), when protruded is moved briskly about like a tactile organ. At its anterior end the sucking-rostrum bears a circlet of small hooks (fig. 9, *d*), which, when in a state of repose, are directed backward and lie close to the rostrum. But when the rostrum is pushed forth, the little hooks become erected so soon as the circlet has issued from the sheath. The tube cannot then be completely retracted again until the hooklets have again bent backwards. How these hooklets are moved it was impossible to ascertain, from the delicacy of the organ under consideration and the difficulty of preparing it. Beyond the circlet of hooks the extremity of the rostrum is arched into a hemispherical form, and terminates at last in a fine point (fig. 9 *f*). The latter is at any rate the termination of the prickle observed by Denny in *Pediculus vestimenti* (see Denny, 10, pl. xxvi. fig. 1, *e*–*h*). By means of this prickle the animal produces a wound, and fixes its rostrum into this with the hooklets. The rostrum consists of firm clear chitine. Posteriorly it is connected with a "kind of internal chitinous skeleton" as Landois (24, p. 36) very characteristically names it. Thus on each side of the rostrum there is a dark-coloured chitinous band (fig. 8 *a* and fig. 9 *a*). These chitinous bands, except for a small indentation close behind the circlet of hooks, run straight until, a little in front of the antennæ, they turn right and left at an angle of about 135°. Attached to these bands at about their middle, and turned towards the rostrum, are a second pair (figs. 8 and 9 *b*), which are at first closely ap-

plied to the former and run in the same direction, but then bend towards one another, and finally run divergently.

It remains to be shown how this simple mechanism acts to push the rostrum out of the sheath. From the middle line of the dorsal integument of the head, above the point of articulation of the antennæ, four muscles start on each side (figs. 4 and 9 *e*) and attach themselves to the above-mentioned chitinous bands *a a*. If then these muscles contract, the chitinous bands *a a* are approximated to each other, and with them also the bands *b b*, which latter will touch about *c*. By this exceedingly simple mechanism the sucking-tube, which lies folded in the space between *a* and *c* (fig. 9), is pressed forth. The hooklets become erected; the prickle comes into action; and the function of sucking begins. A factor of some importance in the function of sucking has still to be noticed. In the extended state the sucking-tube is twice as long as when retracted. The air which was contained in it is therefore diffused over twice the space during protrusion. As, further, there is a firm closure at *c* (fig. 9), there is produced in the extended sucking-tube a more or less exhausted space, according as the tube did or did not contain air before its protrusion. Consequently, without any thing further, the blood will be forced from the wound into the sucking-tube by the pressure of the external air. The sucking-tube, however, is not inactive in this business, seeing that, as a fine tubule, it carries upwards the fluid blood by capillary action. But when the muscles from the dorsal side cease, and at the same time those of the ventral side, which, springing from the hinder part of the head run forward to the middle part of the sucking-tube (fig. 4, *i*), begin to act, the hooklets lay themselves back and the sucking-tube is retracted into the sheath. The space at *c* (fig. 9) is now reopened. By the pressure of the retracted sucking-tube the inhausted blood is driven through *c* into the œsophagus, and thence by the independent movements of the latter passed further on.

The *œsophagus* follows immediately behind the sucking-tube (fig. 8 *œ*). This is a fine tube which passes through the middle and hinder parts of the head, penetrates into the thorax, and then soon opens into the stomach. The membrane surrounding the œsophagus is clear, and exhibits extremely fine transverse striæ. Besides this transversely striated membrane a structureless one also appears to be present.

The *stomach*, that part of the digestive organs which extends from the œsophagus to the Malpighian vessels, is elongated and not very broad. At its upper end it shows on each side of the insertion of the œsophagus two dilatations, which

extend towards the two sides of the thorax. This is its widest part; it then gradually diminishes, has nearly parallel sides for the greater part of its course, and contracts in a conical form towards the point of entrance of the Malpighian vessels. It is 0·704 millim. long, 0·356 millim. broad at its widest part, 0·274 millim. in the middle, and 0·107 millim. at the entrance of the Malpighian vessels. As in all Pediculina, its structure is simple. It possesses two membranes. The outer of these (*tunica gastri muscularis*), which is clear and structureless, is covered by an extremely fine but regular latticework of delicate muscles. The breadth of these does not exceed 0·0011 millim.; the individual meshes of the net vary greatly in size, their greatest breadth being 0·028 and their least breadth 0·013 millim. Upon this membrane within is the *membrana gastri propria*, in which the gland-cells of the stomach are situated. The latter are small oval cells, enclosed by a delicate, clear membrane, and presenting yellow granular contents. Their size varies between 0·010 and 0·022 millim.

The *intestinal canal* in our animal is of moderate length, and describes various ʃ-like bends in its course. The first of its two parts, which are separated from each other by a strong dilatation, the *small intestine* (*ileum*, fig. 12, *i*), considerably exceeds the second, the *large intestine* (*colon*, fig. 12, *a–d*) in length, while it yields to it in width. Beyond the above-mentioned dilatation the intestine decreases in width to one half. Throughout its length the intestinal canal allows three membranes to be clearly distinguished. The innermost (*membrana intima*, fig. 12, *c*) consists of a clear chitinous substance presenting a series of longitudinal fibres or longitudinal layers; in the middle one (*membrana media*, fig. 12, *b*) we recognize a number of small closely approximated cells; lastly, the outermost (*membrana muscularis*, fig. 12, *a*) consists of a great number of strong closely adpressed muscular bundles.

Besides these two parts of the intestine, the above-mentioned dilatation has to be considered. Such a dilatation was noticed by Swammerdam*, as a "Verwijding der Darmen" in *Pediculus capitis*. In the present species it has the form of a funnel, of which the narrow end is turned forward. In this dilatation we distinctly recognize six large oval glandular bodies, with dark granular contents (fig. 12, *e*). These are 0·084 millim. long and 0·055 millim. broad. They are imbedded in the *membrana intima*, are separated from each other by grooves, and surround the lumen of the intestinal

* 10, i. p. 70, tab. ii. fig. 3.

canal (fig. 12, *d*) in a circle. They are the six *rectal glands* of the animal. The whole intestinal canal is accompanied by two strong tracheal stems, one on each side, the ramifications of which go to the wall of the intestine, and run along the grooves which exist between the rectal glands.

As regards the accessory organs of the *tractus intestinalis*, the *Malpighian vessels* have first to be mentioned. These, which are four in number, are inserted into the lower end of the stomach, or into the upper end of the intestine (for no definite boundary can be drawn between the two), and remain isolated throughout their course. They are narrow (0·028 millim.), but attain the considerable length of 1·287 millim., and present a hyaline structureless membrane and finely granular pale yellow contents.

We find two kinds of *salivary glands* in *Hæmatopinus tenuirostris*, elongated and globular, situated on both sides of the upper wall of the stomach. Landois also describes two pairs in *Phthirius inguinalis* and *Pediculus vestimenti*, and names them "bean-shaped" and "horseshoe-shaped" (23, p. 9, and 24, p. 39). The former represent our *globular*, and the latter our *elongated* glands. As regards the latter, they always appear horseshoe-shaped *in situ*, and are 0·473 millim. long and 0·041 millim. broad. The efferent duct, however, is not situated, as in *Phthirius inguinalis*, at the curvature of the horseshoe, but at the end of the gland, so that the whole has the form of a thread thickened and bent back at its upper end. The gland itself is enclosed by a clear structureless membrane; the dark yellow contents show no differentiation. The efferent duct has also a structureless envelope, which forms the continuation of the membrane of the salivary gland; its contents, however, are pale yellow and but slightly granulated. The outer envelope of the *globular* salivary glands is likewise structureless, as also the membrane of their efferent ducts; their contents, however, differ essentially from those of the preceding in so far that they are of a lighter colour and show distinct round cells. The diameter of the glandular ball is about 0·090 millim. The efferent ducts of both are throughout uniformly narrow (about 0·015 millim.), and attain a considerable length. Both pairs of salivary glands are placed close to the upper margin of the stomach, and from this point send forth their efferent ducts parallel to the œsophagus to the mouth.

There remains to be mentioned an organ which was named "liver" by Hooke, and "buik-klier" or "ventral salivary gland" by Swammerdam, but to which Landois gives the indifferent name of the "stomachal disk" ("Magenschiebe").

This is an organ inserted into the upper part of the wall of the stomach, on the ventral surface, and surrounded by a special enveloping membrane, which was observed by the last-mentioned naturalist in *Phthirius inguinalis* and *Pediculus vestimenti* (23, p. 7, and 24, p. 38). Notwithstanding all my endeavours, I have not succeeded in detecting an analogue of this in our animal; so that I think I am justified in supposing that this stomachal disk is wanting in *Hæmatopinus tenuirostris*.

Adipose Body.

The adipose body of *Hæmatopinus tenuirostris* consists of a very great number of separate cells. These are of an elongate oval form, often somewhat pointed at one end, by which means they acquire a pyriform appearance. A fine and delicate membrane envelopes the yellowish green, finely granular contents, which readily allow two nuclei to be recognized. At one end of the oval cell, sometimes the pointed, sometimes the obtuse one, is attached an exceedingly fine pedicle, which connects the fatty body with the great tracheal stems. Thus, especially between the tracheæ and the integument of the body, there is interposed a considerable number of fat-cells. The length of an individual cell is on the average 0·110 millim.; their average breadth is 0·057 millim. Besides these there are, especially in the abdomen, small globular cells which attain only half the size of those first mentioned. These also present a clear envelope, finely granular, but darker-coloured contents, and a pedicle. In the arrangement of the cells of the adipose body there appears to be no regularity; they lie sometimes singly, sometimes united into a mass, sometimes in the neighbourhood of the stomachal wall, sometimes close to the integument of the body. As regards the function of this body, Malpighi, and, following him, especially Leydig, regard it as the "analogue of the omentum of the higher animals." I would rather, however, accept the opinion of Landois, who expresses himself decidedly opposed to the above view, "as the adipose body fundamentally considered will not bear comparison in any single particular with the omentum" (23, p. 10).

Dorsal Vessel.

For a long time I tried in vain to get a sight of the dorsal vessel of *Hæmatopinus tenuirostris*. By the dissection of fresh animals I could not succeed in preparing it. The extremely simple method recommended by Landois, of placing the living animal without any preparation under the microscope, could

not be employed in this case, on account of the opaque epidermis. Finally I succeeded in preparing it from specimens which had lain for months in dilute alcohol.

The *dorsal vessel* (*vas dorsale*) consists of a fine tube which stretches, in the direction of the middle line of the animal, close to the integument of the back, about from the extremity of the abdomen to the middle of the anterior margin of the thorax. So far I could trace it; but it is certain that it does not terminate there, but passes further up into the head (fig. 13, *a*). The tube presents on both sides a great number of appendages, some of which adhere to it by broad surfaces, while others are connected with it only by narrow tubes (fig. 13, *c*). These appendages run in multifarious convolutions, with frequent constrictions, parallel to the sides of the animal to the belly, where they seem to terminate cæcally. At its posterior extremity the tube widens into a peculiar vesiculiform organ, presenting numerous muscular bundles, which lie annularly around it. We also observe in it many elongated fibres running from in front backwards, probably longitudinal muscles. A little before its posterior termination this organ shows on each side a strong muscular bundle, by which it is attached to the integument of the back. We also observe further in the middle and at the upper end of the vesicular structure several strong muscular bundles on both sides, which serve the same purpose as those above mentioned. But as regards the tube itself in its further course, I have nowhere observed upon it any trace of muscles which could effect its attachment to the dorsal integument. It is therefore to be supposed that in this case the whole dorsal vessel is not, as in other insects, attached to the integument of the body by means of numerous muscles which at the same time produce the pulsating movement, but is connected therewith by muscles only at its posterior, and perhaps at its anterior extremity, and otherwise hangs down freely into the body-cavity. The tube itself, as also the vesicular organ at its hinder extremity, appears much darker than the above-mentioned appendages, the colour of which is a dingy grey. The walls of the tube are closed throughout their length, and only give off small narrow canals into the appendages (fig. 13, *b*). The contents of the tube are finely granular; as to the structure of its walls I can say nothing. The appendages, on the other hand, present a fine clear membrane, which is perforated by numerous quadrangular, pentagonal, and hexagonal apertures. Over these is stretched a second layer, which exhibits innumerable extremely fine granules. Upon the appendages we also detect numerous irregular longitudinal and

transverse grooves. In the interior of the space enclosed by the above two membranes we easily observe a number of pale-coloured blood-corpuscles furnished with a thin membrane and a distinct nucleus. They are round and have a diameter of about 0·013 millim. As already stated, the vesicular organ is darker and also furnished with thicker walls than the appendages of the tube. It also presents two membranes—an inner one containing fine granules, and an outer one perforated by small roundish apertures. In its interior also there are numerous blood-corpuscles.

As regards the mode of circulation of the blood in the body of our animal, the following statement may be made. The movement of the dorsal vessel takes place, as in all insects, from the posterior extremity of the tube. The muscles surrounding the vesicular organ, which is an analogue of the heart in the higher animals, contract, and by this means the organ becomes narrowed, and the blood which is pressed out of it, in part directly, but for the most part into the tube, passes out of the latter into its appendages, and comes into contact with the organs of the body through their apertures. That other muscles may not cooperate in this movement is by no means certain. When the tension of the muscles ceases again, the vesicle enlarges to its original size, and the blood goes back into it by the same way that it issued.

The whole circulatory apparatus is accompanied by the finest ramifications of the tracheæ, which convey the oxygen of the air to the blood.

Finally, I have to confirm an opinion of Landois's, which he has expressed with regard to the dorsal vessel. In his 'Anatomy of *Pediculus vestimenti*' (24, p. 40), he says:—"Hitherto my endeavours to prepare the dorsal vessel of the body-louse have been without result, which is explicable by the certainly extraordinary delicacy of the organ. Nevertheless we cannot but ascribe a dorsal vessel to the insect. In favour of the existence of such an organ we have not only the analogy of other insects, but the connecting tubes of the ovaries and testes also indicate it. With regard to these I have convinced myself that the tips both of the strings of ova and of the testes give origin to vessels which possess very fine transversely striated muscular fibres, of which I could especially recognize circular ones, perhaps because they lie outermost. It is these vessels, as we know from insects that have been investigated, which stand in connexion with the dorsal vessel. From the existence of these, therefore, we may deduce the presence of a dorsal vessel." This conclusion, arrived at by Landois, is perfectly correct. I have been

able to trace the vessels which originate from the extremities of the strings of ova to their opening into the appendages of the tube. They originate at *c* in fig. 11, and, after a short course, open into one of the appendages (shown *in situ* in fig. 13, *d*).

Nervous System.

Hæmatopinus tenuirostris has a cerebral ganglion and three thoracic ganglia placed close behind one another. The large cerebral ganglion is situated in the hinder part of the head; in the margin directed towards the forehead it has a small emargination which divides it into two parts, right and left lateral halves. The whole thus acquires the form of a bean. Its length is 0·128, and its breadth 0·190 millim. In front there issue from it on each side to the antennæ two nerves in the form of thin delicate threads. Their course has been already particularly noticed (p. 85). Not far from these there starts on each side a somewhat stouter but shorter nerve, which is appropriated to the eye, the *optic nerve*.

As regards the connexion of the cerebral ganglion with the thoracic ganglia, I was able certainly to distinguish two nerve-filaments at the hinder border of the former and the anterior margin of the first thoracic ganglion; but from their delicacy and the solidity of the integument of the head and thorax, I could not ascertain their further course and the mode of their union; and I see that in this respect I have fared no better than Landois. The supposition, however, seems to be justified that these two nerves establish a connexion, like the commissures in other insects.

The three thoracic ganglia lie close together towards the ventral surface; and the first of them does not extend beyond the middle pair of limbs. The anterior one has a quadrangular form with rounded anterior and posterior angles; its greatest breadth is in front, as is also the case with the other two ganglia of the thorax. In its anterior margin there is a faint scarcely perceptible emargination. The second is more oval, whilst the last decidedly acquires a quadrangular form. The anterior thoracic ganglion is 0·124 millim. broad and 0·093 millim. long; the intermediate one 0·115 millim. broad and 0·091 long; and the posterior one 0·190 millim. broad and 0·128 millim. long. From the three ganglia of the thorax there start on each side in front three nerves, one of which in each case enters into a limb. I have been unable to trace the course of the other two; possibly, as Landois supposes, one of them is a sensitive nerve, while the other is appropriated to the muscles of the body. The first two ganglia have only

these three nerves on each side; the last one, however, possesses several more. In the first place two nerves on each side issue from the middle of the lateral parts of the posterior thoracic ganglion; these were also observed by Landois in *Phthirius inguinalis* and *Pediculus vestimenti*, and regarded by him as "transverse" nerves, "the function of which is to supply the dorsal vessel and the tracheal stems." Besides these, nerves are attached to the hinder part of this last ganglion, five on each side, forming the so-called "cauda equina." These are elongated nerves, which soon divide up into fine threads, and the extremities of which run to the intestines as well as to the generative organs.

The colour of the ganglia is "dark granular." Each ganglion is surrounded by a special, tolerably thick, structureless envelope. The cerebral ganglion and the first two thoracic ganglia show two probably amalgamated lateral halves, while the last thoracic ganglion consists of three parts, two lateral anterior ones and a narrow hinder one. For the rest I would adopt the views of Landois (24, p. 25), who says:—"The two anterior ganglia and the anterior hal es of the third evidently correspond to the three thoracic segments; the hinder part of the third I regard as the contingent belonging to the abdomen."

Female Sexual Organs.

The female generative organs consist of the *ovaries*, the *tubæ*, the *uterus*, the *vagina*, and the *cement-glands*.

Upon the diverticula of the bicornute uterus five *ovarian tubes* arise on each side. In our animal these are bilocular. Whether this is the case throughout the genus *Hæmatopinus* I cannot say, as I have hitherto only examined a few species of the genus in this respect. In those examined (*H. suis*, *H. eurysternus*, and others), however, I have always found bilocular ovarian tubes. But in the structure of the ovaries in general there is a great difference, the importance of which in the classification of the Lice must not be underestimated. Thus in *Phthirius* Landois found *unilocular*, and in *Pediculus septemlocular* ovarian tubes. Should we, therefore, find in animals of the genus *Hæmatopinus* ovarian tubes possessing more or less than two chambers, this would be a reason for grouping the species in question in another genus. However, at present we know so little about the internal anatomy of the Pediculina, that we must content ourselves with the existing arrangement in accordance with purely external characters. We should, however, act very one-sidedly if we were to found a classification of the Lice

upon this single character. A rational classification must be founded upon other equally important characters, such as especially the buccal organs, but not only their external structure, as we already distinguish lice with suctorial from those with biting buccal organs, but also the internal constitution of the organs in question.

The above-mentioned bilocular ovarian tubes are connected with the uterus by shorter or longer *tubæ*. The average length of these tubæ amounts to 0·058 millim., while the greatest observed by me was 0·176 millim. According to the development of the ova contained in them the ovarian tubes present a difference of size and thickness. The lower chamber, nearest to the uterus, is always the largest. In it a single egg attains its development. As soon as this has become mature it is expelled. Then the walls of this chamber shorten, by which the second or upper chamber is brought nearer to the uterus. It is only then that the ovule in this chamber can become developed to its maturity. Thus we find the view expressed by Landois (24, p. 51) confirmed in this case also:—"The ova arrive at their full development in the chamber in which they are placed at first; they do not pass into the immediately underlying emptied chamber in order to become developed." When the ovum has attained its full maturity in the second chamber and been expelled therefrom, the course of development has come to an end in that ovarian tube. In this way the Sharp-headed Ox-louse, if it does not perish previously, may deposit *twenty* eggs. In connexion with this it is to be remarked that in the same individual several eggs may arrive at maturity at the same time, and these are then expelled soon after one another. Most frequently I found in each ovary one ovum approaching maturity; but the presence of *two* in the same ovary was not a rarity. In the latter case, however, the other ovary had only *one* ovum in an advanced state of development. Indeed more than three would not find room in the body-cavity; for a single mature ovum fills nearly one fourth of the abdomen. As regards the size of the different chambers, this is very variable in the case of the lower one, according to the stage of development of the ova, while in the upper one it is more constant. Thus the length of the lower chamber varies from 0·509 to 0·929 millim., and its width from 0·092 to 0·396 millim. The second chamber, on the contrary, which is separated from the former only by a constriction, is 0·156 millim. long and 0·049 millim. wide. It is continued upwards into a tubular structure of 0·078 millim. length (fig. 11 *c*), which unites with the analogous vessels of the other ovarian tubes of

the same ovary, and is connected with the dorsal vessel as already described. The ovarian tubes are enveloped by a clear, structureless, tolerably strong membrane. Landois was the first to make an accurate investigation of the course of development in the chambers in *Pediculus vestimenti*, tracing it step by step in the seven chambers. In that species this was attended with less difficulty, because the most different stages of development occur at the same time in the same ovarian tube; in the present case, on the contrary, I had to examine a whole series of ovaries in order to obtain a clear idea of the gradual progress of the development. I have, however, arrived at exactly the same results as Landois, and may therefore refer to them. I will here cite only one of his principal statements (24, p. 50) :—"The cell situated in the centre," he says, "is the germinal vesicle (fig. 11, *kb*), and its nucleus the germinal spot; the surrounding granular fluid, containing small fat-molecules in suspension, is the vitellus (fig. 11, *d*); the rounded cells, already containing large nuclear structures, placed in the upper part of the chamber are the vitelligenous cells (fig. 11, *db*), and the bacilliform cells lying below them the epithelial layer of the germinal chamber (fig. 11, *estr*)." In the further progress of the development more and more of the vitelline mass is secreted, the vitelligenous cells become smaller, the epithelium becomes more coarsely cellular, and "at the approach of the maturity of the ovum acquires the character of a rounded unistratified layer, whereas it was previously cylindriform." The whole vitellus becomes surrounded by an extremely fine and delicate envelope, the so-called vitelline membrane. Last of all is formed the external envelope of the ovum, the chorion, and, indeed, from the epithelial cells by deposition externally. The chorion is of considerable thickness and of firm consistence. It is not textureless, like the vitelline membrane, but exhibits on its surface numerous hexagonal areas, separated from each other by grooves. Beneath these there is an inner homogeneous layer of the chorion, which exceeds the outer one in thickness. At the upper pole of the ovum, *i. e.* at the end which is furthest from the uterus, when the ovum has attained a certain stage of development, the *operculum* is formed. Upon its production Leuckart (18) says, "According to my observations the operculum is produced in this way. At a certain distance from the anterior pole of the ovum an annular groove makes its appearance, which gradually penetrates deeper and deeper, and finally cuts through almost completely to the vitelline membrane." The complete separation of the operculum, marked off by the groove in question, from

the rest of the chorion, only takes place outside the maternal organism, when the embryo is so far developed that it will soon quit the egg-capsule. Upon the operculum arise some small hemispherical cells, from sixteen to eighteen in number, which form the micropylar apparatus. They occur only on the middle part of the operculum; so that a broad margin remains which shows exactly the same superficial structure as the rest of the chorion. Between the micropylar cells the surface of the operculum is uneven and finely granular. In the middle of each cell of the micropylar apparatus we see a round aperture, the true micropyle. Round this, at some little distance, runs a circular elevation, towards which radiating grooves run from the orifice. From the true micropyle a fine canal passes through the chorion into the cavity of the egg. The micropylar apparatus is only developed on the ovum after all the previously described structures have been produced. It seems to me that the small rounded cells placed above the vitelligenous cells (fig. 11, *m*) take part in its formation. The vitelline membrane is separated from the chorion throughout its whole extent, except at the periphery of the operculum, where the two are firmly united. It has only a *temporary* existence, and disappears during the development of the embryo. At the posterior pole of the egg—that is, at the end which lies nearest to the uterus, there is a peculiar structure, which was also found by Leuckart in the eggs of *Pediculus capitis*, and by Landois in those of *Phthirius inguinalis.* The latter describes it characteristically as a "conical organ which appears as if composed of a tuft of very fine aciculi, springing from a rather dark round space, much like the individual florets in the flower of a composite plant." Whether Leuckart's supposition that this structure is an apprratus of attachment is correct must remain undecided. It is certain, however, that this apparatus is connected with the vitelline membrane, which becomes contracted below into a fine tube, which I could trace distinctly to the structure now under consideration.

The ovarian tubes are connected with the uterus by the *tubæ.* These are slender thin-walled tubes filled with a yellowish cell-mass. The *uterus* is bicornute (*uterus bicornis*); that is to say, it presents two nearly globular diverticula. These open below into the upper broad part of the vagina. Both uterus and vagina have an outer tolerably firm textureless membrane and dark granular contents. The *vagina,* which is surrounded by a network of fine circular and longitudinal muscles, receives the two *cement-glands* before it opens into the cloaca. These are lobulate bodies with an external en-

velope which exhibits numerous longitudinal and transverse grooves, and an inner layer with many dark granular gland-cells. The latter secrete the cement-mass by means of which the egg is attached to the hair of the host.

The fully developed egg has an oval form (fig. 10), and shows two opposite surfaces, which differ considerably in their curvature. Leuckart calls the convex, more strongly curved surface the *ventral*, and the opposite but slightly curved one the *dorsal surface*. He says, "The convex surface corresponds to the ventral surface of the young larva. During the sojourn in the ovary the convex surface seems to be generally turned outward towards the lateral parts of the maternal body." As regards the latter part of this statement Leuckart is perfectly right. But it is not the convex but the opposite slightly curved surface that corresponds to the ventral surface of the embryo. The latter lies in the egg so that its head is placed at the upper or anterior pole of the egg, which bears an operculum, and its back on the convex side of the egg, called the ventral surface by Leuckart (fig. 10); so that here the denominations dorsal and ventral surface must be reversed. A longitudinal section perpendicular to the above-mentioned two surfaces is the only one that divides the egg into two symmetrical halves. The egg is always attached to the hair so that the ventral surface of the embryo is turned towards the hair, by which it is enabled, on quitting the egg-capsule, to climb up on the hair immediately.

The *cement-mass*, which is on the average 0·336 millim. long and 0·318 millim. broad, consists of a hyaline substance. This presents numerous darker streaks, which, attaching themselves at the inferior pole of the egg, pass round the hair and unite with the streaks coming from the other side (fig. 10, *k*). These streaks resemble so many elastic bands, which, on the one hand, maintain the egg in its position, and, on the other, if it should be displaced by external agencies, draw it back again into its place. The hair with the nit attached to it may be best compared, as regards external form, to a tobacco-pipe. The hair represents the tube, the egg the bowl of the pipe, the cement-mass the receptacle, the operculum the lid of the bowl, and the micropylar apparatus the openings in the lid. The operculum of the egg separates in this way: the part lying furthest from the hair first separates from the rest of the chorion, just as, in order to complete the comparison, the lid of the pipe is attached to the bowl at the point nearest to the tube.

It is a remarkable phenomenon in the literature of the Pediculina that we find the eggs neither described nor figured

by the various authors, although we almost always find the nits on animals on which the lice are parasitic. It is true that these escape the eye more easily than the lice themselves, as they often mimic the colour of the hair or of the skin of the host. Denny alone gives figures of the eggs of *Hæmatopinus lyriocephalus*, Burm., and *H. eurysternus*, Nitzsch. And yet the eggs, with their operculum, their micropylar apparatus, and the mode of their attachment, are of no small importance, both as regards the internal anatomy and developmental history and as regards classification.

Male Generative Organs.

The male sexual organs include the *testes*, the *mucus-organs*, and the *penis*.

The *testes*, as in all Lice hitherto investigated, are four in number; and each pair has an efferent duct. They are situated on the two sides of the body, at a considerable distance apart, and are of an oval form. Their width is 0·154, and their length 0·247 millim. The whole testis is surrounded by a pretty firm structureless membrane. Superiorly this passes into a thin thread-like vessel of 0·013 millim. width, with a fine lumen and pale yellow contents, which connects the testis with the *vas dorsale*. Diametrically opposite to this point the envelope of the testis lengthens out to form the seminal duct, which is 0·048 millim. wide and very long. The two testes are situated quite close together; both are attached without any peduncle to the end of the seminal duct. The latter presents a fine textureless membrane, a small lumen, and clear granular contents. Its length is considerable, equalling that of the abdomen. The seminal elements, developed in the testes, consist of a rounded head and a long thin caudal part. As regards the development of the spermatozoids I can at present say nothing, as only a few males of our animal were at my disposal during the investigation.

Between the seminal ducts are placed the *mucus-organs*, two large structures, 0·340 millim. broad, which exhibit a structureless outer envelope and contents consisting of gland-cells. Below these organs contract into efferent ducts, which cross a little way from their point of union, so that the efferent duct of the right mucus-organ approaches that of the left one from the left, and *vice versâ*. A little before they unite these structures receive the two seminal ducts.

The *penis* is a bacilliform strongly muscular organ 0·186 millim. long and 0·049 millim. broad, into which strong chitinous bands are inserted at the sides. The latter run into four chitinous rods, which attain the length of the penis.

Anteriorly the penis, as well as the above-mentioned chitinous bands, is in connexion with the united efferent duct of the mucus-organs and seminal ducts.

Muscular System and Movements.

In the preparation of the muscles I have in general adopted the method recommended by Landois as the most convenient. He describes his process as follows (25, p. 499):—"Select individuals as large as possible, and lay them first of all for a time in dilute alcohol, until a moderate hardening has taken place. Then the individual is divided by a frontal incision, by which the dorsal integument is separated from the ventral. The two halves are now laid in water; and when the viscera have become sufficiently soft they are removed by means of fine needles and hair-pencils. The integument, with the muscles, then remains. Staining brings out the picture." I have divided the animals not only by frontal incisions, but also by longitudinal sections into right and left halves, by which means, besides the dorsal and ventral muscles in the abdomen, previously unsuspected lateral muscles were exhibited. Although certainly the preparation and investigation of the musculature of such small animals is not one of the easiest problems of anatomy, I believe that, from the great number of preparations that I have made, I can give a tolerably complete view of the musculature of *Hæmatopinus tenuirostris.*

The muscular bundles of the Arthropoda consist of the sheath (*sarcolemma*) and the transversely striated contents, the true contractile elements. In our animal I could only in a few instances see the sarcolemma, but I could discover no nuclei in it. The individual muscles break up into fibrillæ, the number of which varies according to the thickness of the muscles. The finest presented only two fibrillæ, while stronger ones had fourteen or more. In the fibrillæ we see darker and lighter layers alternate. These layers are sometimes perpendicular to the long axis; sometimes they form with it an angle varying more or less from a right angle (fig. 5). The interstices between the darker layers produce the transverse striation. In Leydig's opinion (19) they are filled with semifluid substance. At the extremities the fibrillæ terminate conically. By this means they are slightly separated from each other, and thus the muscle appears to be fringed. All the muscles are transversely striated. Only one, the *flexor tarsi*, has a sinewy termination (fig. 6, *ft.*) The length and thickness of the individual muscular fasciculi vary greatly: thus, for example, in the abdomen their greatest length is

0·340 millim., and their least 0·059 millim.; their greatest width 0·066, and their least 0·001 millim.

Musculature of the Head.—The muscles of the head divide into three groups:—those of the buccal organs; the motors of the antennæ; and the motors of the head itself.

Muscles of the Buccal Organs.—Of these there are two kinds. Those which serve for the protrusion of the sucking-tube are inserted upon the dorsal integument of the head in the vicinity of the middle line and at the level of the antennæ, and pass thence, running obliquely forward, to the chitinous bands which exist on each side of the proboscis. There are four of them on each side (fig. 4 *e* & fig. 9 *e*). Their mode of action has been already explained (p. 87). The second group comprises those which effect the retraction of the sucking-tube. They originate on the ventral surface at the base of the head, at a small distance from the middle line, two on each side, and converging anteriorly, accompany the œsophagus, pass between the antennæ, and reach the sucking-tube in front of them. These are fine and exceedingly long muscles (fig. 4, *i*). Their function has been already mentioned.

Muscles of the Antennæ.—Below the muscles which serve for the protrusion of the rostrum two muscles originate on each side at the dorsal surface of the head; and these run parallel to the above mentioned and go to the antennæ. The two muscles of each side lie close together, and only separate a little before reaching the antennæ. One of them goes to the anterior, and the other to the posterior margin of the first antennal joint; the former is the forward and upward motor, the latter the backward and downward motor (fig. 4, *a*). The first antennal joint exhibits four muscles, two of which are inserted at the anterior and two at the posterior end of the base of this joint. These muscular bundles run converging upwards to the lower margin of the second joint. In each of the second, third, and fourth joints we see two muscles. They originate at the base of the joint in which they are situated, run parallel to the longitudinal axis of the joint, and pass to the basal part of the succeeding joint. The fifth joint also has two muscles, which run together above, and probably are destined to move the tactile bacilli.

To the *third* group I refer all the rest of the muscles contained in the lower part of the head.

Immediately below the point of origin of the muscles which go to the antennæ, and in part coincident with them, there goes off on each side a muscular fasciculus to the right and left (fig. 4, *c*). These muscles run from the dorsal surface of the head towards the ventral surface. By their contraction

they approximate the upper to the lower integument, and thus assist in respiration, as will be explained further on. Lastly, we find two more muscles on each side, which, commencing far back on the dorsal surface of the head, run forward (fig. 4, *b' b*), one of them nearly parallel to the middle line (*b'*), the other more towards the ventral surface (*b*). Upon the last-mentioned pair the cerebral ganglion rests. As to the function of these two pairs of muscles I can say nothing with certainty; but I suppose that they also assist in respiration.

Musculature of the Thorax.—The muscles of the thorax may also be divided into three groups—the muscles of the legs, the muscles which serve for the constriction of the thorax, and the motors of the head.

Muscles of the Legs.—These muscles are all attached to the chitinous pad, already repeatedly mentioned, which originates in the middle of the posterior margin of the dorsal surface of the thorax, runs forward in the direction of the median line, then divides and runs towards the anterior angles of the thorax (fig. 4, *l*). These muscles penetrate into each leg. Those going to the first pair originate a little before the point where the above-mentioned chitinous band forks, form with this an angle of about 45°, and are inserted upon the anterior and posterior margins of the base of the coxa; these move the legs forward and backward (fig. 4, *v'*). Immediately behind these the forward and backward motors of the succeeding pairs of legs take their origin, starting from the chitinous band nearly at a right angle (fig. 4, *m'* & *h'*). The musculature is exactly the same in all three pairs of legs, except that the muscles of the first pair are much more delicate than those of the two posterior pairs, as the legs of the first pair are far less powerful than the others. At the base of the coxa originate four muscles which converge forwards, and are inserted upon the lower margin of the trochanter (fig. 6, *c*). The short trochanter exhibits only two muscles, which are tolerably broad at the posterior end, but become considerably narrowed anteriorly and run divergently. They have their origin at the base of the trochanter, and terminate at the lower margin of the femur (fig. 6, *tr*). The musculature of the femur is of a somewhat different type. One muscle traverses the femur from behind forwards, parallel to the long axis of the leg. Two pairs are inserted on each side at some height on the posterior margin of the femur, and run obliquely through it to the anterior margin of the basal part of the tibia (fig. 6 *f*). The three muscles just mentioned are flexors of the tibia. Besides these the femur shows two more muscles, which are inserted on each side above those last named, penetrate into the tibia, and then

unite with the motor of the tarsus (fig. 6, f^1). The *flexor tarsi* has a triple origin. Its principal portion originates in the sinuosity of the tibia which is directed backwards, and runs forwards thence, gradually becoming narrower (fig. 6, *a*); a second part is inserted upon the anterior basal margin of the tibia (fig. 6, *b*), unites, after a short course, with the muscle (f^1) coming from the femur, and both combine with the principal part after they have become considerably narrowed. At its extremity the flexor of the tarsus passes into a fine clear sinew (fig. 6, *ft*). The latter is attached to a finely ribbed chitinous plate (*d*), which is connected with the claw of the tarsus. If then the *flexor tarsi* contracts, the claw is approximated to the chitinous process (*e*) on the anterior margin of the tibia, by which means the animal is able to clasp the hairs of its host.

There are several muscles which serve for the *constriction of the thorax.* The first of these originates above the muscles which run to the first pair of legs, and is inserted upon the anterior margin of the first acetabulum on each side (fig. 4, *x*). The second is inserted between the muscular fasciculi which run to the first and second pairs of legs, and terminates between the first and second acetabula (fig. 4, *z*). The third originates between the muscles going to the second and third pairs of legs, and terminates between the middle and posterior acetabula (fig. 4, *y*). Besides these there is yet a fourth strong muscular bundle, which serves the same purpose. This, which forms a broad band adhering to the dorsal integument, runs from one side to the other at the hinder margin of the thorax (fig. 4, *t*). By the contraction of all these muscles, or of a portion of them, the dorsal integument of the thorax is approximated to the ventral.

Three of these pairs of muscles effect the *movement of the head.* One of them originates on the chitinous pad at the point where this divides, and runs forward to the lateral margin of the head (fig. 4, *r*). The second is inserted above the fork of the chitinous band, and runs perpendicularly to the boundary of the first and second acetabula (fig. 4, *q*), where it meets with the third pair, which commences at the lateral margin of the head, and thence goes obliquely downwards (fig. 4, *p*). All these muscles serve to move the head sideways and downwards. I have been unable to discover any special upward motors of the head, and therefore assume that the chitinous fork which has been repeatedly mentioned acts at the same time as an elastic band which draws the head upwards.

Musculature of the Abdomen.—As in the case of the

muscles of the head and thorax, we shall here also distinguish three groups—the muscles which move the individual abdominal segments, the respiratory muscles, and the muscles of the generative organs.

Motor Muscles of the Abdominal Segments.—At the dorsal surface we find in each segment on each side of the median line five longitudinal muscular fasciculi. The fasciculi placed on the two sides of the median line are distinctly separated from each other by an interspace, which widens towards the middle of the body and narrows again towards the extremity of the abdomen. In the first segment the muscles originate at the posterior margin of the segment, and run, somewhat converging, to the hinder margin of the thorax. These are the elevators of the thorax. The muscles of the other segments are always inserted at the hinder margin of the segments in which they are situated, and run to the hinder margin of the next preceding segment. Besides these we find in the third segment another muscle on each side, which originates close to the other five, but runs outwards and forwards to the hinder lateral margin of the second segment. The length of the muscles in the respective segments is as follows:—

	millim.
In segment 1	0·166
2	0·178
3	0·228
4	0·269
5	0·288
6	0·329
7	0·340
8	0·155
9	0·050

The ventral surface shows five longitudinal muscles on each side in each of the first seven segments, three on each side in the eighth. Those of the first segment are the depressors of the thorax, the others the flexors of the ventral rings of the abdomen. Their insertion and course in the respective rings is exactly the same as with the muscles of the dorsal surface. In the first segment three more muscles on each side originate near the longitudinal muscles, run outwards and forwards, and are inserted upon the hinder lateral margins of the thorax. These are the lateral motors of the thorax.

To the motor muscles of the abdomen we have further to reckon some longitudinal muscles which pass at the lateral margins through the segments from the second to the seventh. There are two pairs of these in each of the above-mentioned segments. Those of the second segment are inserted upon

the hinder margin of the first segment near the dorsal muscles towards the ventral side, and run thence obliquely downwards towards the ventral surface to about the middle of the hinder lateral margin of the second segment. Opposite to their terminations originate the lateral longitudinal muscles of the third segment, which, like those of the other segments, run more parallel to the median line of the whole animal. While the muscles of the dorsal and ventral surfaces by their contraction effect the contraction of the dorsal and ventral integuments, the lateral longitudinal muscles serve for the contraction of the lateral integument.

Respiratory Muscles.—In opposition to the muscles of the first group just described, these traverse the abdomen transversely. They consist of from one to three fasciculi in the respective segments. The first is situated in the middle of the sides of the second segment. It originates near the lateral muscles of this segment and runs towards the ventral surface. In the third segment the respiratory muscle is inserted near the dorsal muscles towards the ventral side, stretches over the lateral longitudinal muscles, and terminates between the latter and the ventral muscles. We also find a muscle of this kind, which, however, is considerably smaller, in the middle of the fifth segment. The other respiratory muscles are situated on the boundaries of segments three to eight. They all originate on both sides of the dorsal muscles, and pass over the lateral longitudinal muscles into the neighbourhood of the ventral muscles. The action of these muscles will be noticed hereafter.

Muscles of the Generative Organs.—In the *female* sexual organs the muscular apparatus is as follows. As already stated, the vagina is surrounded by a number of circular (*c*) and longitudinal (*l*) muscular fibres. From the seventh segment come two muscular fasciculi, which, running obliquely downwards, traverse the eighth abdominal segment, and attach themselves to the vagina in the upper part of the ninth segment. They are long muscular fasciculi, consisting of a great number of fibrillæ. (They may be called *aa.*) On the anterior lateral margins of the ninth segment two shorter and thinner fasciculi are inserted, which stretch somewhat upwards and attach themselves to the vagina a little before the first mentioned (*bb*). At the bottom of the last segment we see on each side a powerful but short muscular bundle, which runs from the sides towards the genital cleft, and has for its office to dilate the latter (*cc*). All these muscles are of great importance in the act of parturition. When the egg has got out of the uterus into the vagina, the longitudinal muscles of

the latter contract; at the same time the muscles *aa* and *bb* also contract. By this means the upper part of the vagina is shortened and the lower part dilated, and the egg is pressed through the abbreviated vagina into its lower dilated extremity. The circular muscles (*c*) now come into action, and force the egg lower down; the muscles *cc* contract and enlarge the genital cleft, and the egg is completely pressed out of the genital aperture.

The muscular apparatus of the *male* sexual organs is much more simple, as indeed lies in the nature of the case. Here we have only two muscles, which originate in the last abdominal segment, and are inserted at the base of the penis. One of them serves to push it forth, the other to retract it after protrusion.

Anatomy and Physiology of the Respiratory Organs.

The respiratory organs of *Hematopinus tenuirostris* consist, as in all insects, of stigmata and tracheæ. Seven pairs of *stigmata* are present. These are placed, as in most Pediculina, somewhat towards the ventral side, and always symmetrically on the two sides of the segments, whereas in other insects they are for the most part situated towards the back. They advance to the middle of the segments, which is also the case in the Pulicidæ and Acanthiadæ. In the other Hexapods, on the contrary, we generally find them between two segments. The first pair is in the thorax at the base of the second pair of legs, and therefore in the mesothorax. This appears to be the case throughout the genus *Hæmatopinus*, in contradistinction to *Pediculus* and *Phthirius*, in which the thoracic stigmata belong to the prothorax. The remaining six pairs are situated in the abdominal segments from the second to the seventh. Besides its size the thoracic stigma is distinguished by its form from the abdominal stigmata. The latter resemble a closed flower-bud (fig. 3), whereas the former rather resembles an open flower. The different stigmata have a small circular aperture surrounded by a chitinous ring (fig. 3, *b*). Parallel to the latter, three other chitinous rings surround the globular stigma. The space between the first ring placed immediately round the aperture and the second, and in the stigmata of the thorax that also between the second and third, are divided into regular areas by radiating grooves. In the bottom of the stigmata, opposite to the external aperture, we observe a number of fine hairs directed outwards. These serve to prevent the entrance of foreign bodies into the air-passages. Below the stigma narrows and passes into the *tunica adventitia* (fig. 3, *d*), on which the tra-

chea abuts. Immediately before this spot the passage between the trachea and stigma is narrowest. Here there is an extremely fine, somewhat curved rod, thickened at its upper extremity, the closing lever of the stigma (fig. 3, *e*). The superior thickened end of this rod is connected in the abdomen with the lateral longitudinal muscles, in the thorax with the median constrictor of the thorax (fig. 4, *x*). Then, as soon as the above-mentioned muscles contract, the lever is set in motion and closes the trachea. When the contraction ceases it opens again in consequence of its elasticity, and the little rod goes back into its position of repose.

The tracheæ exhibit an exterior nucleated membrane, the peritoneal envelope, and an interior chitinous spiral membrane. They are divided into principal and subordinate stems, of which the latter run out into the finest ramifications and go to all the organs of the body. The connexion of the individual stems by the tracheæ is in this case a peculiar one, such as, so far as I know, has hitherto been observed in no insect. From the last abdominal stigma a tracheal stem runs inwards and forwards (fig. 1, *a*). This is united with the corresponding trachea of the opposite side by a transverse stem (*b*). At the point of union the trachea bends suddenly towards the side of the body (*c*). The trachea starting from the penultimate abdominal stigma divides, after a short course, into two branches. One of these (*d*) runs straight forwards, the other (*k*) inwards to the viscera. Into the latter the tracheal stem coming from the last stigma opens. This arrangement is repeated through the whole of the abdomen, so that in each case the main stem of the trachea of the posterior stigma joins the subordinate stem of the trachea of the next anterior stigma. The trachean branch starting from the first abdominal stigma alone unites directly with the main stem from the thoracic stigma. From the latter a branch goes to the anterior legs; the main stem itself passes into the head, and ramifies there. The trachea which starts from the first abdominal stigma and passes into the thorax emits a branch to each of the intermediate and posterior legs. The tracheæ serve, as Landois justly pointed out, both to convey the oxygen of the air to the internal organs of the animal's body, and also to fix the respective organs in their places relatively to the chitinous skeleton and to each other.

In respiration we distinguish expiration and inspiration. Expiration takes place as follows:—When the respiratory muscles which we have found in the head, thorax, and abdomen contract, the body-cavity will be diminished, the interior organs, and especially the cells of the adipose body, will press

upon the tracheæ, by which these are themselves compressed and squeeze out the air contained in them. Expiration is therefore of an active nature. When the air is driven out through the stigmata, the contraction of the respiratory muscles ceases, the body-cavity dilates again, the pressure of the organs upon the tracheæ ceases, the latter expand again by the agency of the spiral thread, and fresh air flows in through the stigmata. Landois thinks that the inspiration is entirely passive. Up to this point certainly; but now the air that has penetrated into the tracheæ has to be driven into the finest capillaries. For this purpose another narrowing of the tracheæ is necessary; but this can be effected only by a constriction of the body, and therefore by the contraction of the respiratory muscles. In inspiration the above-mentioned closing apparatus of the tracheæ is of great importance as Krancher has ascertained. He says (28, p. 516):—"If this were wanting the animal could not breathe at all, and would consequently be incapable of living. Without the closure of the tracheæ the animal, if it wished to breathe, would always expel again the air which is drawn into the body by the corresponding opposite movement, it would never penetrate into the finest ramifications. But when the tracheal closing apparatus comes into action and the tracheæ are full of air, the contraction of the body and the narrowing of the tracheæ consequent upon it presses the air more or less into their finest extremities, where the exchange of gas may take place in the most favourable manner." From what has been said we see that in the Lice both inspiration and expiration are of an active nature.

EXPLANATION OF PLATE III.

Fig. 1. Adult female of *Hæmatopinus tenuirostris*, Burm., seen from the ventral surface, showing the tracheal system, the ganglia, and the hairs.

Fig. 2. Head of *Hæmatopinus eurysternus*, Nitzsch.

Fig. 3. Abdominal stigma of *H. tenuirostris*.

Fig. 4. Head and thorax, seen from the side, showing the muscles and the cerebral ganglion (*d*).

Fig. 5. Upper extremity of a single muscle, greatly magnified.

Fig. 6. Intermediate leg, with the muscles and chitinous thickenings, seen from the side.

Fig. 7. Antenna, showing the chitinous plates, the thickenings and the hairs, and the terminal surface with tactile bacilli.

Fig. 8. Head, with the buccal organs (*a*, *b*), œsophagus (*a*), and eyes (*f*).

Fig. 9. Buccal organs and muscles, more highly magnified.

Fig. 10. Attached egg, with embryo (*e*) and vitellus (*d*).

Fig. 11. Upper chamber of an ovarian tube.

Fig. 12. Ileum, rectum, and colon, with their membranes.

Fig. 13. Upper part of the dorsal vessel. *a*, tube; *c*, appendages; *b*, efferent duct from the tube into the appendages; *d*, appendage connected with the ovaries.

XII.—*On Lepidoptera from Manchuria and the Corea.* By Arthur G. Butler, F.L.S., F.Z.S., &c.

The Lepidoptera here enumerated were obtained last year by Mr. W. Wykeham Perry and Lieut. E. B. Levett, of H.M.S. 'Iron Duke,' and by Lieut. Alfred Carpenter, of H.M.S. 'Magpie.' These collections are especially interesting, as exhibiting a strong resemblance to those received from Japan and the Amur, but at the same time bringing to light several new species. Of the latter, a new *Brahmæa*, allied to the true *B. certhia* of Fabricius, from China, and to *B. Ledereri* of Rogenhofer, from Asia Minor, is perhaps of the most importance; and its capture in place of the nearly allied *B. certhia* (a sketch of which I had forwarded to Mr. Perry) is somewhat singular. That gentleman writes to me respecting it as follows:—"I have sent emissaries all over the Chusan Islands and about Shanghai for *Brahmæa certhia*, Fabr., without success, and gave Carpenter a copy of your sketch, to help him if he came across it. The first day he entered *Chosan* Harbour in *Corea*, the very moth flew on board his vessel. The apparent identity of name may have led to the belief that *Chusan* was the locality where it was first found. The moth, certainly to my eye, looks like Fabricius's species. Chosan (or Fusan) Harbour was once surveyed, very long ago, by an English ship, commanded by a Captain Broughton, when we first attempted to make friends with the Coreans." This moth, however, is evidently a good representative species, differing as much from *B. certhia* of China as that species does from *B. Ledereri*; and the resemblance between the names of the habitats of the two species is consequently a mere coincidence.

The following is an account of the collections; a few common Japanese species sent with them, and, for the most part, taken at sea off Yokohama, are omitted.

Rhopalocera.

1. *Satyrus bipunctatus.*

Satyrus bipunctatus, Motschulsky, Etudes Entom. ix. p. 29 (1860).

Manchuria and Port Lazareff, E. Corea (*W. W. Perry*); near Ashby Inlet, S.E. Corea (*A. Carpenter*).

2. *Argynnis nerippe.*

Argynnis nerippe, Felder, Wien. ent. Mon. vi. p. 24 (1862); Reise der Nov. Lep. iii. pl. 50. figs. 1, 2 (1867)

♂. Jinchuen, W. Corea, twenty miles west of the Corean capital Séoul (*E. B. Levett*).

The specimens are all males; they are a trifle larger and brighter in colour than Japanese specimens; and the black spots of the discal series vary in size.

3. *Argynnis coreana.*

Argynnis coreana, Butler, Ann. & Mag. Nat. Hist. ser. 5, vol. viii. p. 15 (1882).

Jinchuen (*E. B. Levett*); Port Lazareff (*W. W. Perry*), S.E. Corea (*A. Carpenter*).

The specimens are all males, and seem to approach much nearer to *A. nerippe* ♂ than the original specimens; the brand on the first median of primaries is either wholly absent or feebly indicated as in typical *A. nerippe*, whereas in *A. coreana* type it is so much expanded as to form a marked feature in the pattern of the insect.

4. *Argynnis vorax.*

♂. *Argynnis vorax*, Butler, Trans. Ent. Soc. p. 403 (1871); Lep. Exot. p. 151, pl. liv. fig. 1 (1871).

♀. Paler above than the male; much like a large form of *A. chloradippe* ♀, but with the black spots rather narrower: below also much like an exaggerated female of that species, but altogether paler with the silver spots larger but less brilliant; the secondaries less golden, with the ocelli and inner edges of the submarginal silver spots very dark. As in the male, the primaries are far more falcate than in *A. chloradippe*, and the abdominal margin of the secondaries longer.

♂ ♀. Jinchuen (*E. B. Levett*).

Only a single pair of this species was obtained; the male only differs from the type from Shanghai in its heavier submarginal spots. It differs much, on the underside, from the female, the ground-tint being, as usual, much brighter, the primaries being destitute of silver spots, and the secondaries having no trace of silver on the submarginal spots. It thus more nearly resembles *A. alexandra*, Herr.-Sch.

5. *Argynnis japonica.*

Argynnis laodice, var. *japonica*, Ménétriés, Cat. Acad. Petr. Lep. ii. p. 102, pl. x. fig. 3 (1857).

One worn male. Barracouta Harbour, in Manchuria, Gulf of Tartary (*W. W. Perry*).

6. *Hestina assimilis.*

Papilio assimilis, Linnæus, Mus. Lud. Ulr. p. 300 (1764).

♂. Ashby Inlet; ♀. Flew on board August 1882, S.E. Corea (*A. Carpenter*).

The pair of this Chinese species obtained by Lieut. Carpenter is in fine condition, the female showing no trace of rubbing.

7. *Pyrameis cardui.*

Papilio cardui, Linnæus, Fauna Suecica, p. 276 (1761).

One worn example. Gensan, Port Lazareff, E. Corea (*E. B. Levett*).

This cosmopolitan species is noted by its captor as "a very rapid and strong flier."

8. *Lycæna japonica?*

Lycæna japonica, Murray, Ent. Month. Mag. xi. p. 167 (1874).

A female. Barracouta Harbour, Manchuria, July 31, 1882 (*W. W. Perry*).

The specimen is not perfectly typical, and may be a much-worn *L. pseudægon*, Butl.; but, from its poor condition, it is impossible to be sure that it is distinct from *L. japonica*.

9. *Lycæna argia.*

Lycæna argia, Ménétriés, Cat. Mus. Petr. Lep. ii. p. 125, pl. x. fig. 7 (1857).

Three worn examples. Ashby Inlet, S.E. Corea (*A. Carpenter*).

One female specimen is much dwarfed; and both females are smaller than Japanese specimens.

10. *Lycæna ægonides.*

Lycæna ægonides, Bremer, Lep. Ost-Sib. p. 28. n. 128, pl. iii. fig. 8 (1864).

Manchuria (*W. W. Perry*).

Both sexes somewhat worn; the males are not quite so broadly bordered with black as in Bremer's figure; but as the species evidently varies in this respect ("der schwarze Rand ist noch breiter als bei *L. Aegon* und *erstreckt sich oft bis über die Mitte des Flügels*," *Bremer*), there can be little doubt about their being conspecific. *L. iburiensis* of Japan is nearly allied but larger, with shorter and less distinctly white fringes; the colour is also of a paler, more silver-greyish tint above; and below the wings are more dead-white, with larger well-defined black spots, excepting towards the outer margin of primaries.

11. *Lycæna Levettii*, sp. n.

Allied to *L. argiolus* and *L. ladonides*. From the former the male differs in the broader and less sharply defined blackish border to the outer margins of the wings and the greyer tint

of the under surface: the female differs in its darker tint and broad external blackish border to the secondaries; the costal border is also broader, so that the silvery blue area is confined to a triangular abdominal patch; below the white is a trifle less pure, and the submarginal lunules a little better defined than in *L. argiolus*. From *L. ladonides* the male is readily distinguished by its lilacine instead of cærulean colour, and the female by its greyer tint throughout, and its more decided broad blackish external border to secondaries; both sexes also are decidedly smaller, as in *L. argiolus*, and have the submarginal lunules and spots below much less strongly defined. Expanse of wings, ♂ 30–34 millim., ♀ 33 millim.

Jinchuen, W. Corea (*E. B. Levett*).

Seven examples in a more or less recognizable condition were obtained, two pairs being in very fair trim. As the characters given above seem to be quite constant, and do not admit of their being placed with any of the allied species, I am compelled, somewhat against my wish, to regard *L. Levettii* as distinct.

12. *Everes hellotia*.

Lycæna hellotia, Ménétriés, Cat. Mus. Petr. Lep. ii. p. 124, pl. x. fig. 6 (1857).

S.E. coast of Corea (*A. Carpenter*).

13. *Chrysophanus timæus*.

Papilio timæus, Cramer, Pap. Exot. ii. pl. clxxxvi. E, F (1779).

♂. Jinchuen, W. Corea (*E. B. Levett*).

The specimen belongs to the variety *C. stygianus*.

14. *Terias Mariesii*.

Terias Mariesii, Butler, Trans. Ent. Soc. London, 1880, p. 198.

S.E. Corea (*A. Carpenter*).

Two males agreeing with fig. 4 of my plate.

15. *Terias Hobsoni*.

Terias Hobsoni, Butler, Proc. Zool. Soc. 1880, p. 668.

S.E. Corea (*A. Carpenter*).

A single female example.

16. *Ganoris crucivora*.

Pieris brassicæ, var. *crucivora*, Boisduval, Sp. Gén. i. p. 522 (1836).

Jinchuen, W. Corea (*E. B. Levett*).

17. *Leptosia amurensis.*

Leucophasia amurensis, Ménétriés, Bull. Acad. Petr. xvii. p. 213 (1859); Schrenck's Reisen, ii. p. 15, pl. i. figs. 4, 5 (1859).

Manchuria (*W. W. Perry*).

18. *Papilio hippocrates.*

Papilio hippocrates, Felder, Verh. zool.-botan. Ges. Wien, xiv. p. 314. n. 356 (1864).

♂. W. Corea (*E. B. Levett*).

19. *Papilio xuthus.*

Papilio xuthus, Linnæus, Syst. Nat. 1, ii. p. 751. n. 34 (1767).

Jinchuen, W. Corea (*E. B. Levett*). Flew on board off Manchuria, August 1882 (*W. W. Perry*).

20. *Papilio xuthulus.*

Papilio xuthulus, Bremer, Bull. Acad. Petr. iii. p. 463 (1861); Lep. Ost-Sib. p. 4, pl. i. fig. 2 (1864).

Jinchuen, W. Corea (*E. B. Levett*); S.E. coast of Corea (*A. Carpenter*).

21. *Papilio Dehaanii.*

Papilio Dehaanii, Felder, Verh. zool.-bot. Ges. Wien, xiv. p. 323. n. 251, p. 371. n. 268 (1864).
Papilio bianor, var., De Haan, Verh. Nat. Ges. Ned. overz. Bez. pl. v. figs. 1, 2 (1840).

♂ ♀. Jinchuen, W. Corea (*E. B. Levett*).

This species is confounded with *P. japonica* in Kirby's 'Catalogue.' The latter species may readily be distinguished by its more opaque primaries, *the narrower and yellower whitish band across the under surface of these wings*, and the very feebly developed scarlet borders to the submarginal lunules on the upper surface of secondaries, which in *P. Dehaanii* ♂ frequently extend almost to the apex, whereas in *P. japonica* ♂ there are never more than two (the smallest number ever found in Felder's species), and sometimes none at all, visible without a lens *.

* Speaking of these green *Papiliones* I may call attention to the fact that *P. Raddei* from the mountains of Bureia has been *guessed* to be a seasonal form of *P. Maackii*. How this can be I cannot imagine, since *P. Maackii* is a common species in Japan, whereas no specimen of *P. Raddei* has ever been taken there.

22. *Papilio nicconicolens.*

Papilio nicconicolens, Butler, Ann. & Mag. Nat. Hist. ser. 5, vol. vii. p. 139 (1881).

S.E. Corea (*A. Carpenter*).

A single somewhat shattered female, having the scarlet submarginal spots usually found in females of the group to which this species belongs.

23. *Plesioneura bifasciata.*

Eudamus bifasciatus, Bremer & Grey, Schmett. N. China's, p. 10 (1853).
Goniloba fasciatus, Ménétriés, Cat. Mus. Petr. Lep. i. pl. v. fig. 3 (1855).

Jinchuen, W. Corea (*E. B. Levett*).

The left-hand side of Ménétriés's figure is very incorrect; the transparent yellowish spots form an interrupted oblique band: the under-surface representation is better; but the band is still not so oblique as it should be.

Heterocera.

24. *Macroglossa stellatarum.*

Sphinx stellatarum, Linnæus, Syst. Nat. 1, ii. p. 803. n. 27 (1766).

Near Vladivostock, August 1882 (*W. W. Perry*).

25. *Procris budensis.*

Procris budensis, Speyer, Geogr. Verbr. i. p. 466 (1862).

Jinchuen, W. Corea (*E. B. Levett*).

This agrees with an Amur specimen in our collection examined by Dr. Staudinger when last in London; and therefore I am satisfied to regard it as Speyer's species. At the same time the distribution of the insect ("Hungary, Sarepta, Armenia, Amur Land, W. Corea") seems a little wild.

26. *Brahmæa Carpenteri*, sp. n.

♀. Size and shape of *B. certhia* (*lunulata*, Brem.), but altogether paler, the disk of the wings beyond the black area almost white; basal area and lower half of central belt of primaries black, between these two black areas nine irregularly dentate-sinuate black stripes; the upper half of the central belt longitudinally streaked with pale sandy whitish in the manner of *B. certhia*, but much paler; the outer edge of the band more regularly undulated above the middle, the discal area beyond it broader, crossed by nine (instead of seven) black lines; submarginal ocelli with white dashes, as in *B.*

Ledereri: secondaries with the paler disk crossed by twelve black lines, as in *B. Ledereri* (not ten, as in *B. certhia*): thorax and head deep black, with sandy brownish borders to the collar and tegulæ, as in *B. conchifera* of Northern India; the abdomen also is blacker than in the immediate allies of the species. Expanse of wings 139 millim.

Flew on board at 9 P.M., 28th July 1882, Chosan Harbour, Corea; caught by Dr. Renshawe.

This moth has the clumsy rounded wings of *B. certhia*; but the markings, with the exception of the pale patches on the central belt of primaries, more nearly agree with those of *B. Ledereri*. Some lepidopterists have associated the two species, without doubt having had no opportunity of examining the Chinese species, owing to its extreme rarity in collections.

27. *Odonestis læta.*

Amydona læta, Walker, Cat. Lep. Het. vi. p. 1416. n. 6 (1855).

Vladivostock, 19th August, 1882 (*W. W. Perry*).

A single example, much shattered, of the paler variety. The species has a wide range; it is in the Museum collection from Silhet, Burmah, and Java.

28. *Spirama jinchuena*, sp. n.

Allied to *S. japonica*, the male not so black, and consequently showing the black lines much more distinctly than in that species; the central pair of wavy lines on the disk of primaries considerably blacker and almost as sharply defined as those on each side of them; the submarginal lines on the male secondaries indistinct, but clearly discernible without a lens, whereas in *S. japonica* they are wholly absent, and in *S. simplicior* are perfectly black and well defined; the pale postmedian stripe flesh-coloured instead of whitish in the female, and the central belt preceding it blacker. Wings of male below smoky brown, with three equidistant darker stripes across the disk; primaries with a blackish spot in the cell and an oval blackish annulus at the end of the cell: secondaries with a blackish spot at the end of the cell. Female below bright brick-red, with blackish stripes and spots as in the male; body of both sexes red below. Expanse of wings 58–67 millim.

Jinchuen, W. Corea (*E. B. Levett*).

We also have a male specimen from the province of Che-kiang, China.

29. *Spirama inæqualis*, sp. n.

Allied to the preceding and to *S. simplicior*; sexes very much alike, the male being slightly more smoky than the female, and (as usual) with no pale basal area to the secondaries; the male can at once be distinguished from that sex of *S. simplicior* by the want of definition in the markings of the secondaries, in which respect it agrees with *S. jinchuena*; both sexes, however, are readily separable from the latter by the innermost stripe on the under surface being much further from the middle stripe than the latter from the outermost one; also by the more ochraceous colouring of the under surface and the somewhat paler upper surface, the incurving of the basal area of the male and sometimes of the central belt of the female and its greater width. The male below reddish, somewhat as in *S. simplicior*, with darker stripes and spots exactly as in the female. Expanse of wings 60–62 millim.

♂. Port Lazareff, E. Corea (*W. W. Perry*); ♀. S.E. Corea (*A. Carpenter*).

30. *Egnasia curtalis.*

Egnasia curtalis, Walker, Cat. Lep. Het. Suppl. iv. p. 1177 (1865).

S.E. coast of Corea (*A. Carpenter*).

31. *Idæa hanna.*

Acidalia hanna, Butler, Ann. & Mag. Nat. Hist. ser. 5, vol. i. p. 401 (1878); Ill. Typ. Lep. Het. iii. p. 40, pl. 50. fig. 11 (1879).

Jinchuen, W. Corea (*E. B. Levett*).

Only one much-worn example was obtained of this Japanese form.

32. *Icterodes sordida*, sp. n.

♀. Nearly allied to *I. transectata* of the Himalayas: primaries sandy olivaceous, with the disk whitish; costal border ochraceous; basal fourth covered with transverse black spots and dashes, much narrower than in *I. transectata*, and followed consequently by a much broader almost unspotted band of the ground-colour; a large semicircular black spot within the cell, followed immediately by a sigmoidal band of spots from costa to inner margin; this, again, is followed by two closely approximated waved bands of black spots which bound the whitish discal area; a band of large oval spots across the disk; a submarginal series alternated with a marginal series which extends over the fringe: secondaries bright golden ochreous, with greyish striations at the base; a large black spot at the end of the cell, followed by three series of unequal

spots, the outermost alternated with black spots on the fringe: body as usual. Expanse of wings 50 millim.

Jinchuen, W. Corea (*E. B. Levett*).

33. *Abraxas miranda.*

Abraxas miranda, Butler, Ann. & Mag. Nat. Hist. ser. 5, vol. i. p. 441 (1878); Ill. Typ. Lep. Het. iii. p. 48, pl. lii. fig. 12 (1879).

Jinchuen, W. Corea (*E. B. Levett*).

34. *Hymenia fascialis.*

Phalæna (*Pyralis*) *fascialis*, Cramer, Pap. Exot. iv. pl. 398. fig. O (1782).

S.E. coast of Corea (*A. Carpenter*).

35. *Lozotænia? congruana.*

Dichelia congruana, Walker, Cat. Lep. Het. xxviii. p. 320. n. 13 (1863).
Tortrix shanghainana, Walker, *l. c.* p. 327. n. 47.

S.E. coast of Corea (*A. Carpenter*).

Walker's types are in poor condition; but nevertheless I have little doubt that they should be referred to *Lozotænia*, and placed near to *L. fucana*.

XIII.—*On* Sphenopteris crassa (*Lindley and Hutton*). By Robert Kidston *.

[Plate IV.]

Sphenopteris crassa, L. & H., Fossil Flora, pl. clx. (1835).
Adiantites pachyrrachis, Göppert, Die fossilen Farrnkräuter, p. 387 (1836).
Cyclopteris pachyrrachis, Unger, Synopsis Plantarum Fossilium, p. 56 (1845).
Cyclopteris adiantoides, Unger, Genera et Species Plantarum Fossilium, p. 100 (1850).
Adiantites crassus, Schimper, Traité de Paléontologie Végétale, vol. i. p. 425 (1869).
Sphenopteris Kiowitzensis, Stur, Die Culm-Flora, Band i. p. 32, pl. vi. fig. 8 (1875).
Calymmotheca Kiowitzensis, Stur, Die Culm-Flora, Band ii. p. 151 (1877).

Perhaps no fossil plant of equally rare occurrence has received so many names as the present species. More than half

* Read before the Royal Physical Society, Edinburgh, 17th January, 1883.

of the synonyms have been created by systematists who, differing in opinion as to the genus in which the plant should be placed, appear to have thought that, on its being removed from one genus to another, they were quite justified in also applying a new specific name.

Since this fern was described by Lindley and Hutton in 1835, and the publication of Schimper's 'Traité de Paléontologie Végétale' in 1869–74, three different designations have been applied to it, in none of which was any trace of the original name preserved.

The first alteration was made by Göppert in his work 'Die fossilen Farrnkräuter,' where he classes *Sphenopteris crassa*, L. & H., with *Adiantites*, and gives it a new specific name (*pachyrrachis*), without assigning any reason for the change. At that time the sole example which appears to have been known to him was the original type specimen, as he only mentions Burdiehouse as its locality. Little excuse can be made for such total disregard of priority of name.

In 1845 Unger placed this fern in the genus *Cyclopteris*, and retained Göppert's specific name for the species. The same author five years later, in his 'Genera et Species,' altered the specific name to *adiantoides*, to avoid confusion, as another *Cyclopteris*, from the Lias, had been described under the name of *Cyclopteris pachyrrachis*.

No further change took place in the designation of this plant till 1869, when Schimper again placed it in the genus *Adiantites*, but restored the original specific name of *crassus*.

My attention was specially directed to this fern when going over the fossil plants in the Museum of Science and Art, Edinburgh. In the "Hugh-Miller Collection" were two specimens from Burdiehouse, one of which agreed entirely with the description and figure of *Sphenopteris Kiowitzensis*, Stur; but on the lower part of the specimen were a few pinnules similar to those on the figure of *S. crassa*, L. & H.

From the original plate and description of Lindley and Hutton I could not, however, determine whether the plant described by Stur was a distinct species or only a more perfect specimen of *Sphenopteris crassa*.

On searching I was successful in finding the type of *S. crassa*, L. & H., in the Museum in connexion with the class of geology in the University of Edinburgh, an examination of which at once showed that the specimens in the "Hugh-Miller collection," and the *S. Kiowitzensis*, Stur, belonged to *S. crassa*, L. & H.

The type specimen shows the lower part of a frond, the axis of which bifurcates about an inch above the base of the portion which has been preserved.

No pinnæ are borne on the rachis below the bifurcation; but on the left-hand side of the left arm of the fork three pinnæ are given off (Pl. IV. fig. 1). On the right-hand side of the same arm of the fork only one is produced; but below it we have two large cyclopteroid pinnules, which occupy an analogous position on the stem to that of the pinnæ.

On either side of the axis, below the bifurcation, large cyclopteroid pinnules are also situated, similar to those on the inner side of the left and on the remaining fragment of the right-hand arm of the bifurcation.

On the highest pinna, the form of the pinnules changes and assumes a rhomboidal outline, the margins being more or less deeply cleft.

The rachis shows little scars from which scales have probably fallen.

On the specimen in the "Hugh-Miller Collection," one of the pinnæ towards the lower part of the fossil shows the cyclopteroid pinnules; but on the greater portion of the specimen their form is rhomboidal (Pl. IV. fig. 2).

The last-mentioned pinnules are composed of a number of cuneate segments, united together in a fan-like manner, the central one being the longest, on either side of which the truncated apices of the segments give a dentate outline to the pinnule, which is broadest near its centre.

These must be regarded as the typical pinnules, the cyclopteroid pinnules only occurring towards the base of the frond.

The difference between these two forms of pinnules is so marked that, unless they had been observed on the same frond, one would scarcely imagine that they belonged to the same plant.

In the figure of this species in the 'Fossil Flora' the dimorphic nature of the pinnules has not been brought out, though on the specimen it is distinctly shown on the uppermost pinna.

The plant which Stur has described under the name of *Sphenopteris Kiowitzensis* represents the middle part of a frond.

His specimen likewise shows a dichotomy of the main axis, as well as the dimorphic nature of the pinnules.

In referring to the affinities of his specimens, Stur says:—"Our plant shows almost as near a relationship with *Sphenopteris crassa*, L. & H., from the Carboniferous Limestone of Burdiehouse. This has the rachis simple below, above bifurcated, and bears pinnules, which likewise decrease from above downwards (?).

"But in the English plant the lobulation is different, the lobes being much broader, and the divisions between them appearing, on the contrary, less deep."

The inaccuracies in Lindley and Hutton's figure, to which I have previously alluded, are sufficient to justify Stur in describing his plant as a new species.

In the second part of his 'Culm-Flora,' the author removes this fern from *Sphenopteris*, and places it in his new genus, *Calymmotheca*, the chief character of which is the many-valved sporangium—one of his species (*Calymmotheca minor*) in fact being, as already pointed out by Mr. C. W. Peach, probably a small specimen of *Staphylopteris Peachii*, Balfour*.

As the fruit of *Sphenopteris crassa* is unknown, there is no evidence that it belongs to the genus *Calymmotheca*, Stur; hence I retain it in the genus *Sphenopteris*.

From the examination of specimens of *Sphenopteris crassa*, L. & H., which have come under my notice, I would propose the following description of the species:—

Sphenopteris crassa, L. & H.

Main axis dichotomous, and marked with small transverse scale-scars. Frond tripinnate (?); pinnæ alternate, linear lanceolate; pinnules alternate, those towards the lower portion of the frond cyclopteroid and sessile, more or less deeply laciniate, the upper pinnules rhomboidal, broadest towards their centre, and narrowing into a short stalk at their basal extremity, apex truncate, margins more or less deeply notched; veins springing from the base of the pinnule and extending to the margins, numerous and frequently dichotomizing.

Position and Localities. From the Calciferous Sandstone series: Burdiehouse, near Edinburgh; Straiton Brickworks, Loanhead (*Mr. J. Gibson*); and Kilmundy Limestone Quarry, near Burntisland (collected by *Mr. J. Bennie*, fossil-collector to the Geological Survey of Scotland).

My thanks are due to Prof. Archer, for permission to describe and figure the specimen in the "Hugh-Miller Collection," Museum of Science and Art, Edinburgh, and to Prof. A. Geikie, Director General of the Geological Survey of Great Britain, and Prof. J. Geikie, of the University of Edinburgh, for the use of the specimens in their custody.

* Peach, "On Fossil Plants from the Calciferous Sandstone around Edinburgh," Trans. Bot. Soc. vol. xiii. 1877.

EXPLANATION OF PLATE IV.

Sphenopteris crassa, L. & H.

Fig. 1. Type specimen of the species. From Burdiehouse, near Edinburgh.
Fig. 2. Larger of the two specimens in the "Hugh-Miller Collection," Museum of Science and Art, Edinburgh; also from Burdiehouse.

XIV.—*On some new Species of* Curculionidæ *from Ceylon.* By Francis P. Pascoe.

The Curculionidæ described in this paper were collected by Mr. George Lewis during a recent visit of five months to Ceylon. His captures amounted to over 10,000 specimens, including 1200 species *. No such collection has been made before; indeed, I believe, since Sir Emerson Tennent's time, only a few stray specimens have ever reached this country. Notwithstanding the rich vegetation, the insect-fauna of Ceylon is rather disappointing so far as large and gaily-coloured species are concerned; but some of its apparently peculiar forms are unusually interesting. The Curculionidæ number about 70 species; of these I have only here described the duplicates. They were, as will be seen further on, almost entirely collected in the mountain-district of Dikoya, at altitudes varying from 3800 to 4200 feet. Galle and Colombo, lying on the shore, are "rich in species." Mr. Lewis only spent a week in one and about three weeks in the other; but very few Curculionidæ seem to have been met with. The following is a list of the species here described:—

Apioninæ.

Apion maculipes.
—— æneipenne.

Attelabinæ.

Apoderus pulchellus.

Rhinomacerinæ.

Rhynchites clavatus.
Eugnamptus marginatus.

Alcidinæ.

Alcides Lewisii.
—— ruptus.
—— curialis.
—— guttulatus.
—— suspensus.
—— argutor.

Zygopinæ.

Podalia, n. g.
—— mimica.

* For an interesting account of the visit, see Trans. Entom. Soc. 1882, pp. 475–483.

CRYPTORHYNCHINÆ.
Amphialus, n. g.
—— turgidus.
—— agrestis.
Phrygena, n. g.
Phrygena ephippiata.
(—— affinis, note.)
Strattis, n. g.
—— biguttatus.
—— vestigialis.

Apion maculipes.

A. ovatum, convexum, nitide nigrum, pedibus testaceis, genis tarsisque, dimidio basali articuli primi excepto, infuscatis; rostro tenui, tertia basali incrassata; funiculo extrorsum infuscato; prothorace elongato, pone medium constricto, leviter sparse punctato; elytris breviusculis, obovatis, striato-punctatis, interstitiis planis, humeris callosis. Long. 1⅓ lin. (rost. incl.).

Hab. Kandy.

Ovate, convex, glossy black; legs, except the tibio-femoral joint and tarsi (but basal half of the first joint testaceous), brownish; rostrum slender; eyes large, subapproximate above; antennæ testaceous, the last five joints of the funicle brownish; prothorax much longer than broad, constricted behind the middle, finely and sparsely punctured; scutellum distinct; elytra shortly ovate, the shoulders callous, finely striate-punctate; interstices flattish; body beneath and the four posterior coxæ black.

This *Apion* is about the size and shape of *A. nigritarse*, but is more glossy, with a differently formed prothorax, and the coloration of the antennæ and legs different. Kandy is not more than 1700 feet above the sea; the botanical garden of Peradeniya is here.

Apion æneipenne.

A. ovatum, convexum, nigrum, nitidum, elytris fusco-æneis, pedibus rufescentibus, tarsis saturatioribus; antennis fuscis; rostro modice elongato, tertia basali incrassata; capite rude punctato; oculis subapproximatis; prothorace cylindrico, tenuiter punctato; elytris ovalibus, striato-punctatis, interstitiis planis, subtilissime punctatis. Long. 1⅓ lin. (rost. incl.).

Hab. Kandy.

This species has the habit of the preceding; but the coloration is different, the prothorax is not constricted, and the elytra are oval rather than obovate. The only other *Apion* in the collection is *A. ceylonicum*, Gerst.

Apoderus pulchellus.

A. glaber, nitidus, rufo-castaneus; elytris singulatim plaga oblonga flava ornatis, lateribus sterni maculis duabus stramineo-sericeis indutis. Long. 3⅓ lin. (rost. incl.).

Hab. Dikoya.

Smooth, glossy, rufous or reddish chestnut, a large, oblong pure yellow patch (but slightly interrupted towards the middle) on each elytron, a short distance from and parallel with the suture; head elongate obconic, depressed between the eyes; antennæ as long as the head and prothorax together in the male, much shorter in the female; prothorax impunctate; scutellum large, very transverse; elytra striate-punctate, punctures large, approximate; body beneath dark chestnut; meso- and metasternal epimera covered with a silky straw-coloured pubescence; legs varying from rufous to brownish.

About the size and contour of *A. Dohrnii*, Jek., but at once distinguished from its congeners by the large yellow oblong patches on the elytra.

Rhynchites clavatus.

R. nigrescens, elytris fusco-æneis; rostro longitudine capitis cum prothorace; clava antennarum laxe elongata, funiculo articulis quinque basalibus testaceis, apice paulo infuscatis. Long. 1¼ lin.

Hab. Dikoya.

Minutely pubescent, blackish; elytra dark brassy brown; rostrum slender, as long as the head and prothorax together; antennæ with the five basal joints of the funicle testaceous, but a little darker at the apex, the club loosely elongate, and, with the last two joints of the funicle, blackish; prothorax longer than broad, minutely and closely punctured; elytra short, striate-punctate, punctures moderately approximate, interstices flattish; body beneath and legs dark steel-blue, coxæ fulvous.

This species is similar to our *R. æneovirens*, but is much smaller, and has the club of the antennæ differently formed.

Eugnamptus marginatus.

E. testaceus, scutello, elytrorum sutura marginibusque nigrescentibus; femoribus, apice excepto, testaceis, hoc, tibiis, tarsis, antennis rostroque nigris. Long. 2½ lin. (rost. incl.).

Hab. Dikoya.

Thinly pubescent, testaceous; scutellum, suture, and margins of the elytra blackish; femora testaceous, except at the apex, this, with the tibiæ, tarsi, and antennæ being dull black, the latter pubescent; rostrum glossy black, except a little testaceous at the base; prothorax longer than broad, inclining to luteous, and but slightly pubescent; scutellum subquadrate; elytra somewhat depressed, the sides parallel, striate-punctate, punctures moderately approximate, interstices flattish; body beneath testaceous, the metasternum blackish.

Allied to an unpublished species from Madras in my collection, which, *inter alia*, has the elytra more closely punctured and the apex black. I have two species from Pará, neither allied to their North-American congeners.

Alcides Lewisii.

A. oblongo-ovatus, niger, nitidus, prothorace vittis quinque, elytrisque singulis vittis tribus (exteriore apice ad interiorem conjuncta, tertia intermedia abbreviata) ochraceis ornatis. Long. 4½–5 lin.

Hab. Dikoya.

Oblong-ovate, black, shining, closely granulate; prothorax with five, and each elytron with three, pure ochre-yellow stripes, the inner stripe on the latter abruptly diverging behind the middle, and joining the outer or marginal stripe at a sharp angle close to the apex, the third or intermediate stripe tapering from the base and extending to a little beyond the middle; body beneath with small non-approximate scales, but more dense on the propectus and sides; legs with scattered hair-like scales.

I have the pleasure of naming this handsome species after Mr. Lewis, who has done so much for Eastern entomology, and to whom I am indebted for the species described in this paper.

Alcides ruptus.

A. oblongo-ovatus, niger, prothorace vittis quinque, elytrisque vitta exteriore alteraque interiore pone medium (apice conjunctis), plagis duabus ad latera, una posteriore ad vittam exteriorem adjuncta, vitta basali intermedia abbreviata, ochraceis ornatis. Long. 4–4½ lin.

Hab. Dikoya.

This species is very closely allied to the last; but, without the variation in the disposition of the stripes on the elytra, it may be distinguished by the remotely placed granules on the interstices (not running together and forming an almost continuous line), and the intervals between the granules being well covered by approximate ochreous scales, so hiding the derm beneath as to give the upper surface a more opaque appearance. The principal variation in the elytral stripes is that the outer one is interrupted, the upper portion forming an oblique patch at the shoulder.

Alcides curialis.

A. ovatus, niger, nitidus, prothorace vittis quinque elytrisque singulis vitta abbreviata basali, maculis duabus ad humeros, fascia pone

medium (ad suturam haud extensa), et signo v-formi apicali ochraceis ornatis. Long. 5 lin.

Hab. Dikoya.

Ovate, glossy black; prothorax with five stripes, and on each elytron a short stripe near the scutellum, two spots on the shoulder, a postmedian band (not extending to the suture), and a V-shaped mark at the apex pure ochre-yellow; elytra striate-punctate, punctures large, approximate, interstices with the granules coarse and irregular; body beneath with small approximate ochreous scales; legs with elongate scattered scales.

This and the two preceding species form another isolated group in this large genus, whose characters are so precise, but whose members in so many instances leave such large gaps between them. The bifid, or simple claws connate at the base, however, have ceased to be characters of generic importance.

Alcides guttulatus.

A. obovatus, niger, supra granulis nitidis (interstitiis dense silaceo-squamosis) indutus; rostro sat valido, rude punctato; antennis piceis; elytris basi prothorace paulo latioribus, striatis; pedibus ferrugineis. Long. 4½ lin.

Hab. Bogowantalawa.

Obovate, black, with glossy granules above, the intervals covered with yellowish-brown scales; rostrum rather stout, not longer than the prothorax, coarsely punctured, with short prominent longitudinal lines between; antennæ dark pitchy; prothorax irregularly granulate; elytra broadest at the base, striate-punctate, punctures nearly hidden by the scales, but apparently linear, each interstice with a row of rather remote granules, becoming gradually smaller posteriorly; body beneath pitchy, with fewer scales; legs ferruginous, sparsely scaly; tarsi pitchy.

Not unlike *Lixus bicolor* in general appearance, but a little stouter. In the two individuals before me one has three distinct small yellowish spots behind the middle of the elytra (two outer conjoined), one at the shoulder and another towards the apex; in the second there are two spots only in the middle and none at the apex. Bogowantalawa is from 4900 to 5200 feet in altitude.

Alcides suspensus.

A. ellipticus, niger, subnitidus, prothorace vittis quinque, elytrisque singulatim vittis quatuor (interiore prope scutellum incipiente ad apicem extensa, duabus extus basalibus in medio conjunctis, quarta postica marginali) fulvis ornatus. Long. 2¾ lin.

Hab. Kitulgalle.

Elliptic, black, somewhat glossy, five stripes on the prothorax and four on each elytron pale tawny yellow; on the latter, one starts from the side near the scutellum, then curving a little outwards is continued to the apex, two outer and basal stripes are connected by a transverse bar just before the middle, the fourth stripe is marginal, occupying the posterior half, and joins the inner one at the apex; rostrum slender, longer than the prothorax, glossy black; antennæ pitchy; prothorax conical, rather closely granulate between the stripes; elytra slightly broader than the prothorax at the base, striate-punctate, the interstices, except where the stripes intervene, closely granulate; body below covered with pale ocreous scales; legs, except the black coxæ, reddish pitchy, sparsely scaly.

This species may be grouped with the following and two or three other elliptic forms as yet undescribed.

Kitulgalle is 1700 feet above the sea.

Alcides argutor.

A. ellipticus, piceus, squamulis piliformibus subaureis indutus; elytris maculis quatuor ante medium, quatuor pone medium, vittisque duabus apicalibus fulvis notatis. Long. 2½ lin.

Hab. Dikoya.

Elliptic, pitchy, covered with very small, yellowish, somewhat golden scales; rostrum slender, longer than the prothorax, finely punctured; antennæ dark pitchy; prothorax conical, irregularly and rather closely granulate; scutellum punctiform; elytra scarcely broader than the prothorax at the base, striate-punctate, punctures indistinct, each interstice with a row of rather remote granules, four small spots just before and four behind the middle, and two stripes meeting at the apex of each elytron, all of a dull yellowish colour; body beneath sparingly scaly; legs ferruginous, with scattered hair-like scales; tarsi pitchy.

PODALIA.

Rostrum breviusculum, modice arcuatum; *scrobes* medianæ, infra rostrum currentes. *Antennæ* breves; *funiculus* 7-articulatus, articulo primo majusculo, ultimis quinque transversis; *clava* ampla. *Oculi* magni, antice approximati. *Prothorax* normalis. *Scutellum* parvum. *Elytra* prothorace haud latiora. *Rima* pectoralis inter coxas anteriores postice terminata. *Abdomen* segmentis duobus basalibus ampliatis; *pygidium* obtectum. *Pedes* breves, antici majores; *femora* dentata; *tibiæ* anticæ apice mucronatæ; *tarsi* (articulis tribus basalibus simul sumptis) cuneiformes.

A genus whose nearest ally appears to be *Copturus*; but widely different in the short, stout legs, especially the anterior pair, the rostrum in repose not extending to the mesosternum, the shortness of the antennæ, the scape not extending to the eye, and other characters. The exponent of this genus has a marked resemblance to *Menemachus stigma*.

Podalia mimica.

P. ovalis, fusca, setulis pallido griseis vestita, pedibus antennisque pallidioribus vel subferrugineis. Long. $1\frac{1}{3}$ lin.

Hab. Galle.

Oval, slightly depressed above, dark brown, covered with pale greyish setulæ varied with silaceous, the elytra with a few indefinite blackish spots; rostrum much shorter than the prothorax, slightly broader at the tip, the basal half seriate-punctate, bicanaliculate beneath, the scrobe cutting into the canal on each side; antennæ subferruginous, second joint of the funicle conical, shorter than the first, the remainder very short and gradually broader, the club large, oval; prothorax narrowed anteriorly, rounded at the sides, not contracted at the base; scutellum small, embayed by the elytra; the latter striate-punctate, punctures indistinct; body beneath and legs with greyish setulæ.

AMPHIALUS.

Rostrum modice elongatum, cylindricum, paulo arcuatum; *scrobes* terminales, ad partem inferiorem oculi desinentes. *Oculi* infra subacuminati. *Antennæ* tenues; *funiculus* 7-articulatus, articulis duobus basalibus elongatis; *clava* distincta. *Prothorax* transversus, basi truncatus, utrinque rotundatus, lobis ocularibus prominulis. *Scutellum* minutum. *Elytra* subglobosa. *Pectus* breve, late excavatum, antice emarginatum. *Meso-* et *metasternum* brevissima. *Abdomen* segmento primo amplissimo, tribus sequentibus brevibus; *processus* interfemoralis late truncatus. *Femora* obsolete dentata; *tibiæ* flexuosæ, calcaratæ; *tarsi* breves; *unguiculi* liberi; *coxæ* anticæ contiguæ, intermediæ separatæ.

An *Acalles*-like form, but with a broad shallow excavation (hardly a canal) on the short pectus. This character seems to ally it to Lacordaire's "sous-tribu Ithyporides." The unusual character of the second abdominal segment not being longer than either the third or fourth is also found in *Ithyporus* itself.

Amphialus turgidus.

A. ovatus, fuscus, supra nitide nigro-granulatus, inter granula sat

dense squamosus; elytris valde convexis, postice fascia flexuosa alba notatis; rostro antico rotundato. Long. 3 lin.

Hab. Dikoya.

Ovate, dark brown, with numerous glossy shining granules above in the midst of rather closely-set palish scales; rostrum rounded in front, scaly throughout; antennæ pitchy, first two joints of the funicle as long as the rest together; prothorax with a well-marked longitudinal groove, granules irregularly scattered, some bearing a short erect black scale; scutellum small, semicircular; elytra very convex, strongly grooved, the grooves foveate, interstices with a line of somewhat remote granules; body beneath and legs closely scaled, with longer bifid scales intermixed, last four segments of the abdomen with a few hair-like scales only.

Amphialus agrestis.

A. ovatus, fuscus, supra nitide nigro-granulatus, inter granula dense squamosus; rostro antice bicarinato. Long. 2½ lin.

Hab. Dikoya.

Allied to the preceding, but at once differentiated by the two carinæ or elevated lines on the rostrum, and the two shorter basal joints of the funicle; the prothorax has a shallow longitudinal groove free from granules; and the elytra, longer in proportion and less convex, have on each a white somewhat semilunar spot behind the middle. The spots, however, as well as the band of the last are liable to be effaced, and are probably not to be depended on, as is the case in many others of the same family.

PHRYGENA.

Rostrum tenue; *scrobes* antemedianæ, infra rostrum euntes. *Antennæ* funiculo primo incrassato, quam secundus longiore. *Oculi* rotundati, laterales. *Prothorax* transversus, irregularis, apice productus, lobis ocularibus prominulis. *Scutellum* punctiforme. *Elytra* ovata, convexa, prothorace latiora. *Rima* pectoralis ad metasternum extensa, postice indeterminata. *Abdomen* segmentis duobus basalibus amplis; processus interfemoralis late truncatus. *Femora* in medio incrassata, mutica; *tibiæ* basi compressæ, calcaratæ; *tarsi* articulo tertio ampliato; *unguiculi* liberi. *Corpus* squamosum et fasciculatum.

Allied to *Colobodes*, but with the pectoral canal extending to the mesosternum, and of course with the anterior and intermediate coxæ apart. The canal, however, is not so definite posteriorly as in the "Tylodides." I have a second species from Singapore *.

* It is closely allied to the Cingalese species here described; but the broad ridge on the prothorax is rather convex above, without the excava-

Phrygena ephippiata.

P. brevitor ovata, albo-squamosa; elytris, tertia apicali excepta, fuscis; prothorace apicem versus paulo excavato; pedibus annulatis. Long. 2 lin.

Hab. Dikoya.

Shortly ovate, closely covered with white scales, the elytra brown, except the apical third; rostrum as long as the prothorax, scaly throughout, brown in the middle; antennæ testaceous; prothorax broadly ridged in the middle, and slightly excavated behind the projecting apex, edges of the ridge bounded by a fascicle of erect white scales anteriorly and behind by a few black ones, sides external to the ridge concave throughout; elytra broadest at the base, gradually rounded to the apex, the shoulders extending beyond the prothorax, striate-punctate, the punctures linear, third, fifth, and seventh interstices fasciculate towards the base, a second series of fewer scales on the middle, and a still lessening series on the apical third; body beneath with small whitish scales; legs closely covered with white scales alternating with rings of brown.

STRATTIS.

Femora infra canaliculata et *scutellum* distinctum ab *Acalle* distinguunt.

Acalles is one of those genera which do not appear to be very easy of definition; Lacordaire hesitated to consider it distinct from *Tylodes*, with which it was originally placed by Schönherr as a subgenus, with *A. camelus* as the type. Later on, in his 'Genera et Species,' he gave as the type an obscure Cuban species, *A. apicalis*. At any rate the characters here given cut off the two species described below from *Acalles*.

Strattis biguttatus.

S. breviter ovatus, fuscus; elytris in medio singulorum macula sordide alba notatis; rostro extrorsum ferrugineo; antennis testaceis. Long. $1\frac{1}{3}$ lin.

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tion at the apex, and is without the black scales at the side; the elytra at the apex are abruptly declivous; and the legs are not ringed.

Phrygena affinis.

P. breviter ovata, albo-squamosa; elytris, tertia apicali excepta, fuscis, apice subito declivibus; prothorace apicem versus paulo convexo, lateribus minus excavatis. Long. 2 lin.

Hab. Singapore.

Hab. Dikoya.

Shortly or rather broadly ovate, dark brown; elytra with a small well-defined dirty white spot on the middle of each; upper surface set with numerous short, erect black scales; rostrum nearly as long as the prothorax, punctured at the base and gradually smoother and ferruginous towards the apex; antennæ testaceous; prothorax very transverse, narrow at the apex, rapidly expanding and rounded at the sides; scutellum round, elevated, smooth; elytra a little broader than the prothorax, callous at the shoulders, very indistinctly seriate-punctate; body beneath ferruginous, with pale scattered scales imbedded in punctures; legs short, dark brown.

This species in a certain degree resembles *Acalles roboris*.

Strattis vestigialis.

S. ovalis, fuscus, fere obsoleto albo varius; elytris postice fascia indeterminata alba notatis; rostro antennisque piceis. Long. $2\frac{1}{4}$ lin.

Hab. Dikoya.

Oval, dark brown, with a few almost obsolete dirty white patches, assuming a band-like form towards the posterior part of the elytra, or the whole apical third more or less whitish; rostrum shorter than the prothorax, and, with the antennæ, pitchy; prothorax very transverse, rather flattish above, slightly concave at the sides, closely punctured; scutellum blackish; elytra moderately convex, striate-punctate, punctures linear, not approximate, interstices slightly raised; body beneath pitchy, with approximate whitish scales; pectoral canal not extending beyond the anterior coxæ; legs pitchy, covered with narrow and some erect scales.

In this species the canal is shorter than in the preceding or in *Acalles* generally.

XV.—*Observations on the Generic and Specific Characters of the* Laganidæ. By Professor F. JEFFREY BELL, M.A.

1. *History of the Name.*—The generic term *Laganum* has had a somewhat chequered history. Introduced into science by the very founder of our knowledge of the Echinoidea, it was left unnoticed by Leske in his "Additamenta" to the work of Klein. When first used as a strictly generic appellation its form was a little modified—Dr. Gray, in 1825, copying, as it would seem, from p. 9 of Klein's 'Dispositio' without noting that, at the top of the page, there are the words

"exhibemus in," and that all the accusatives that follow are in the plural number. In his article "Scutelle" (1827), de Blainville exhibits no acquaintance with the work of Gray; but in 1830, in the article "Zoophytes," he adopts and uses Gray's term *Lagana* *. Finally, L. Agassiz returned, in 1841, to the correct and ancient form of the name.

2. *Structural Characters.*—There would appear to be some considerable difficulty, not so much in judging as to the forms which belong to the Laganidæ, as in the determination of the value of the characters of the species. We may justly assume that no greater weight, at any rate, than that which is due to specific characters can be given to the general form of these always flattened subpentagonal Echinids; nor do they, with their simple spines and their fairly regular tubercles, offer us therein any useful mark of distinction. As shall now, however, be shown, there are two points of value on which some importance has been laid—the genital pores and the internal structure of the test. The pores may be four or five in number, intra- or extrapetaloid in position; and the septa or walls, which unite the actinal and abactinal plates, vary in the extent of their development.

In his classical monograph on the Scutellidæ, Professor Louis Agassiz directs attention to the characters of the genital pores in the following words (p. 107):—"il est un point de l'organisation des Laganes qui offre de graves difficultés, c'est la variété qui règne dans le nombre des pores génitaux, une partie des espèces en ayant invariablement cinq, tandis que d'autres n'en ont que quatre. J'ai vainement cherché à rattacher ce fait à quelque autre caractère constant de l'organisation; mais n'ayant reconnu dans la structure de l'appareil génital à l'intérieur aucune différence entre les espèces qui ont quatre pores et celles qui en ont cinq, j'ai dû renoncer provisoirement à les diviser." And a similar remark is made by Desor †: "Comme sous tous les autres rapports la ressemblance est très grande, nous n'avons pas cru pouvoir séparer les deux types."

A somewhat different aspect is given to the matter by the remarks of Mr. Alexander Agassiz on p. 520 of his well-known 'Revision.' "Agassiz had already hinted at the probable generic separation of *L. Peronii* from *Laganum*;

* The possessor of the 'Revision of the Echini' may make, therefore, the following corrections on p. 137 in the "Synonymy" of the generic name:—After *Scutella* in thick letters should follow *Lagana*, Gray, 1825, Ann. Phil. n. s. vol. x. p. 427; and the date 1827 after the name of de Blainville should be altered to 1830.

† Synopsis des Echinides fossiles, p. 228.

this had been adopted without further proof by Gray, Desor, Michelin, and Hupé, who have independently established a distinct genus, based upon the peculiar position of the genital opening, far away from the abactinal system, in the interambulacra; but as we have a true *Laganum* in which the genital openings (*L. Putnami*) have the same extrapetaloid position, this feature alone cannot be of any generic value."

I need not stop to point out that the concluding portion of the sentences just quoted appears to be an example of a cyclical method which, however admirable in an ancient poet, fails to carry conviction to a modern scientific audience; but I am anxious to put in a clear light exactly what the naturalists just named really did do, and to relieve them from the charge of hastily erecting genera that has been made against them.

Taking first the case of Dr. Gray, we find that, in his 'Catalogue of the Recent Echinida' (1855), pp. 8–13 are occupied by an account of the genus *Laganum*, which is divided into three sections. The definition of the third runs thus:—

*** *Genital pores 4, large (posterior wanting), far apart, and between the upper part of the ambulacra.* Peronella.

The zoologist who is acquainted with Dr. Gray's works will know that a name is thus not unfrequently given by that naturalist to a division of a genus. A definite reason for the course adopted can hardly be given; but a reasonable method of procedure will generally allow the student to discover the amount of value which Dr. Gray himself attached to these names. A reference to p. 3 exhibits to us a "Synopsis of the Genera," and there *Laganum* stands undivided, and is not accompanied by the term *Peronella*; a reference to p. 66 gives us a systematic index, and there 12 species are ascribed to the genus *Laganum*, the last being written "12. *L. Peronii.*" Dr. Gray therefore did not establish, with, or without "further proof," a genus *Peronella*.

Michelin's genus (*Polyaster*) was not even established on a species with the genital openings in a "peculiar position;" for his figure clearly shows the type to be no other than *L. decagonalis*. With this the genus of *Dujardin & Hupé* is absolutely identical, their name *Michelinia* being substituted in consequence of the prior application of the term *Polyaster* to a starfish.

Neither Michelin nor Dujardin & Hupé formed, therefore, genera on the extrapetaloid position of the genital pores; I should presume, however, as Hupé is referred to without the

mention of the name of Dujardin, and as his genus is distinctly stated to have been established "independently," that some other work than their well-known compilation was being referred to, were it not that that work is referred to by Mr. Agassiz in his synonymy, and that Hupé's independent contribution to echinology (in 'Amér. du Sud,' Castelnau) does not contain any new genus allied to *Laganum*.

Desor alone remains; and it will be of interest to see on what characters that distinguished naturalist based his genus *Rumphia* *.

"Grands oursins plats; plus ou moins renflés au sommet, amincis vers le bord. Quatre pores génitaux. Pétales allongés, effilés, jamais fermés. Zônes porifères sensiblement plus étroites que la zône interporifère. Face inférieure plate. Péristome petit, à fleur du test, entouré d'une étoile péristomale distincte et de cinq tubes buccaux. Périprocte rapproché du bord. Point de cloisons à l'intérieur. Cinq auricules au lieu de dix, comme chez les Clypéastres."

The type of the species is *Laganum rostratum*; and, so far from Desor having selected a form in which the genital pores occupy an extrapetaloid position, we find the sentence to run thus:—"Nous envisageons comme type de ce genre le *R. rostrata* (*Laganum rostratum*, Agass.). Peut-être conviendrait-il de faire également du *Laganum Peronii* le type d'un nouveau genre. C'est une question sur laquelle nous reviendrons en traitant des oursins vivants."

Unfortunately for the study of the Echinoidea, M. Desor does not seem to have ever carried out this intention. It would seem therefore to be more in consonance with the facts known to us to say rather that Desor "hinted at the probable generic separation of *L. Peronii* from *Laganum*," than that he ever made a genus equivalent to *Peronella*. And this view is supported by the fact that the only fossil form ascribed by Desor to this genus is the species figured by Herklots and called by him *Scutella decagona*, a form which is, as we learn from Dr. Martin, "undoubtedly identical" with what Agassiz calls *Peronella decagonalis* †.

In other words, Desor no more than Gray, Michelin, or Hupé formed a genus for the reception of *L. Peronii*; or, yet in other words, the utmost that any of these naturalists has done has been to hint, as did Desor, at the "probable generic

* Synopsis des Echinides fossiles, p. 220.

† See the important and valuable "Revision of the Fossil Echini from the Tertiary Strata of Java" (in Notes Leyd. Mus. ii. p. 78), by Dr. K. Martin.

separation" of *L. Peronii*, or, as did Gray, to divide the species of the genus into three groups, one with five, one with four apical, and one with four extrapetaloid genital pores.

No capable naturalist has ever yet given a generic position on the strength of the character now under discussion, or so acted as to render necessary the protestation that "this feature alone cannot be of any generic value."

On the other hand, it is to be borne in mind that the change that has taken place in the position of the genital pores is, as Lovén has shown, one that affects rather the ducts than the so-called genital plates; and that being so, it is clear that we have to do here with an arrangement which, in two organisms of essentially the same structure, might, under similar conditions, independently appear: or, in other words, we have a good and sufficient reason for not using the position of the genital orifices as the bases for generic *coupes*. So far as this particular character is concerned, we may safely say that it affords no evidence in favour of a closer alliance between *L. Putnami* and *L. Peronii* than between either of these and some other members of the genus.

We may now pass to the second distinguishing character, or, rather, to that which has been used as such. In recognizing the subgeneric distinctness of *Peronella*, Prof. Alex. Agassiz states that he bases "the distinction entirely upon the internal structure of the test in *Peronella*. The partitions forming the connecting walls between the upper and lower floor ramify somewhat as they do in *Scutella* and *Arachnoides*, and extend more than halfway to the centre of the test from the edge, instead of forming a narrow belt of three or four concentric simple walls near the edge."

I shall now endeavour to show that these differences in structure are really due to differences in age; but, for the purposes of the investigation, I may limit myself to that part which lends itself most easily to accurate and detailed measurements.

A specimen of *P. decagonalis*, determined by Prof. Alex. Agassiz, and coming from St. 212 (H.M.S. 'Challenger'), with four genital pores, has a radial measurement of 22·3 mm.; and the partitions extend inwards 7·3 mm. from the edge, or rather less than one third of the distance.

A specimen, bearing the same name, from St. 219, with five genital pores, with a radial length of 22 mm., has the partition 8·5 mm. from the edge, or about two fifths, but still considerably less than one half.

Similar results are obtained by the measurements of other

forms; and they may be summed up in the following Table:—

Species.	Radius.	Extent of partition.	Percentage.
L. Putnami	11	3	27·27
"P. decagonalis" (young).	11	4	36·36
"L. Peronii"	19	8·5	44·7
L. depressum............	21	9	42·8
"P. decagonalis"	41	23	56
"P. decagonalis"	46	27	58·4

It is clear enough that these figures do not support the doctrine of a marked difference between the species of *Laganum* and *Peronella* in the extent of the development of the partitions; but they do point in a most significant manner to the apparent relation between the size of the test and the development of the internal supporting walls; and we are led to see without surprise that a species placed by one naturalist with those in which the "sinus cécaux du bord" are "limités à une zone étroite," may be set by his son among those in which the partitions are said to ramify and extend some distance inwards (*L. decagonum*).

In fine, we are irresistibly led to the conclusion that these partitions present us with variations which are largely due to growth, and, for the rest, available only as marks of specific differentiation.

The fact that in the technical definition of the genus *Laganum* A. Agassiz says "five genital openings," and in that of the subgenus *Peronella* "four genital openings," would lead the commencing or unwary student to suppose that that author attached some weight to the difference in number. As a matter of fact, however, he (and, as it would seem, with perfect justice) unites, under the head of *P. decagonalis*, forms with four and forms with five pores.

3. *General Results of the Investigation.*—The evidence adduced leads to the union of *Peronella* (A. Ag.) with *Laganum*. In the examination of the question of the character of the systematic relations of the species of the Laganidæ, we have been compelled to enter with as much detail into the views of earlier naturalists as into the lessons to be learnt from structural characters. We have found that, driven from point to point, they had come to see that in the characters of the pores, in the form of the partitions, the only two points of difference were to be expected. Some forty years ago the elaborate studies of Louis Agassiz convinced him that the variations in the number of the pores could not be brought into association with any other variations that could be re-

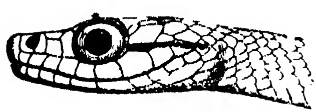
garded as having a generic value; but he still seemed to look with favour on, and later he and his co-worker E. Desor, and again still later Desor separately, made some use of, the partitions. Alex. Agassiz, adopting his father's distinctions, has separated off as a subgenus the forms in which the partitions seemed to be better developed. These differences I have shown in these observations to depend on age more than, rather than as much as, on species; and the last reason for separating *Peronella* (A. Ag.) from *Laganum* is hereby removed.

The real case would seem to be best and most truthfully represented by allowing that, in the case of Laganidæ, some of what we call specific characters are by no means definitively fixed.

XVI.—*Description of two Snakes from the 'Challenger' Collections.* By Dr. A. GUNTHER, F.R.S. &c.

AMONG the Snakes collected by the naturalists of the 'Challenger' Expedition there were two which are apparently undescribed. They, with a number of others which were desiderata in the British Museum, are now deposited in the national collection.

Tropidonotus dendrophiops.



Habit slender; head resembling that of *Dendrophis*; eye very large. Scales in seventeen rows, strongly keeled. Ventrals 157; anal divided; subcaudals 100. Anterior frontals subtruncated in front, nearly as long as posterior. Loreal large, somewhat longer than high. One præocular, reaching to the upper surface of the head, but not to the vertical. Three narrow postoculars. Upper labials nine, the fourth, fifth, and sixth of which enter the orbit, and are narrow on account of the large size of the eye. Temporals irregular in size and arrangement; two are in contact with the postoculars. The maxillary teeth form one continuous series, and

increase somewhat in size posteriorly. Greenish brown, with a series of small yellowish spots along each side of the back, each spot being surrounded with a deeper tint of the ground-colour. Lower parts white, with black spots, which from the second third of the length of the trunk become more numerous, those along the middle of the posterior third forming a central series. Each subcaudal with a large black spot on the side.

One specimen from Zamboanga (Philippine Islands); it is 36 inches long, the tail measuring 11 inches.

Dipsas aruanus.

Scales in 23 rows, those of the vertebral series large, subhexagonal. Ventrals 258; anal entire; subcaudals 90. Loreal quadrangular, nearly as high as long. One præocular, reaching the vertical; two postoculars. Nine upper labials, the fourth, fifth, and sixth entering the orbit. Temporals rather irregular, 2+3+3. Two pairs of chin-shields, subequal in size. Brownish olive, with very indistinct and irregular markings. Traces of a temporal streak. Lower parts yellowish, dotted with grey on the posterior parts of the abdomen; subcaudals nearly uniform, like the back.

A single specimen from Wokau, Aru Islands; it is 51 inches long, the tail measuring 10 inches.

XVII.—*Notes on some Indian Fishes in the Collection of the British Museum.* By Dr. A. GÜNTHER, F.R.S. &c.

Carcharias Murrayi.

Snout short, obtuse, the distance between the mouth and the extremity of the snout being less than the distance between the inner angles of the nostrils. Nostrils nearly midway between the extremity of the snout and the mouth. The teeth of the upper jaw are of moderate size; but their number cannot be exactly given, owing to the accidental absence of

those situated near the angle of the mouth. The anterior are equilateral, rather longer than broad; but those on the sides are distinctly oblique, with the posterior edge concave and both edges very finely serrated. Teeth of the lower jaw in 29 sets, lanceolate, but without a swelling near the point, which is characteristic of *Carcharias glyphis*; their edges are smooth, and the base broad, two-rooted, sometimes with an additional minute lobe. Pectoral fin large, longer than the distance of the first gill-opening from the extremity of the snout; and the length of the hind margin is only one fourth of that of the anterior. The first dorsal commences opposite to, or immediately behind, the axil of the pectoral. The second dorsal is only one third the size of the first, but conspicuously larger than the anal, which is small; origin of the anal behind that of the second dorsal. Caudal fin of moderate length, its length being rather more than the distance between the two dorsal fins. Coloration uniform, the top of the first dorsal appears to have been black.

One specimen has been obtained from the Kurrachee Museum, after whose accomplished curator, Mr. J. A. Murray, the species is named; it was obtained at Kurrachee.

Its measurements are:—

	ft	in.	lin.
Total length	6	8	6
Distance of the snout from the root of the pectoral	1	6	0
" " first dorsal	2	0	6
" " end of first dorsal	2	9	0
second dorsal	4	2	0
end of second dorsal	4	6	0
anal fin	4	4	0
" commencement of caudal fin	4	11	0
Length of upper caudal lobe	1	8	0
" lower caudal lobe	0	9	6

Akysis pictus.

D. 1/6. A. 9. P. 1/7.

Similar in general habit to a *Cottus*. Head much broader than deep. The eyes are twice as distant from the gill-opening as from the end of the snout, and widely distant from each other. Nasal barbels half as long as the head; the maxillary barbels extending to the origin of the dorsal fin, outer mandibulary barbels to the inner axil of the pectoral, the inner ones being shorter. Origin of the dorsal fin midway between the end of the snout and the adipose fin; its spine is comparatively strong. Origin of the anal fin nearer to the root of the caudal than to that of the pectoral. Caudal emar-

ginate. Pectoral fin extending a little beyond the origin of the dorsal, with a strong non-serrated spine; ventrals reaching the vent. Head greyish, minutely punctated with black. Trunk black anteriorly, the black colour being contracted into an irregular band, which runs along the middle of the posterior part of the trunk and of the tail. Dorsal fin black, with whitish margin; caudal and pectoral fins punctulated with black.

Two specimens, 45 millim. long, from Tenasserim; presented by J. Wood-Mason, Esq.

Erethistes, M. & Tr.

= *Hara*, Blyth.

The diagnosis of these supposed two genera were given in the 'Catalogue of Fishes,' from the descriptions published by their authors. These descriptions have proved to be incomplete or faulty, and the two genera to refer to the same fish. The amended characters will be as follows:—

Two dorsal fins, the anterior with a strong spine, the posterior adipose and rather short; anal short. Teeth in both jaws minute; palate edentulous. Mouth small, at the lower side of the conical snout. Barbels eight: nasal barbel very small, attached to the flap covering the posterior nostril; basal fringe of the maxillary barbels short. Anterior and posterior nostrils close together. Eyes small, without free orbital edge. The superficial bones of the head with granular surface, forming a strong armature; humeral processes elongate, protecting each side of the abdomen. Ventral fins six-rayed, inserted below the dorsal. Gill-membrane confluent with the isthmus opposite to the root of the humeral process.

These characters are taken from specimens of *Erethistes hara*. The genus is most closely allied to *Callomystax*.

Olyra, McCl.

This genus was known to me, at the time of the publication of the fifth volume of the 'Catalogue of Fishes,' from McClelland's description only. The British Museum has now received specimens through the kindness of Mr. Wood-Mason, which enable me to amend the diagnosis of the genus, as well as to insert it into its proper place in the system proposed by me. The genus* belongs to the group Silurina; and I should be

* *Branchiosteus*, if entitled to generic distinction, would, of course, follow *Olyra*.

inclined to place it in the vicinity of *Saccobranchus*. The characters are:—

Adipose fin low; dorsal short, without spine, placed above the ventrals; anal long. Jaws and vomer with bands of minute villiform teeth; cleft of the mouth transverse, anterior, of moderate width; barbels eight. Eyes small; head covered with soft skin. Caudal with the upper portion prolonged, of lanceolate shape (or rounded?). Ventrals five- or six-rayed. Gill-membranes separated by a deep notch. Anterior vertebræ coalescent.

Dwarf Siluroids, inhabiting mountain-streams south of the Brahmaputra, and of the Malayan peninsula.

Olyra elongata.

D. 7. A. 19. P. 1/4. V. 5. Vert. 3+17/23.

The depth of the body is one twelfth of the total length (without caudal), the length of the head one sixth. Eye behind the level of the angle of the mouth, small, about one half of the length of the snout, and of the width of the interorbital space. The maxillary barbels extend to the base of the pectorals; mandibulary and nasal barbels short. Jaws even in front. Base of the ventral fins nearer to the vent than to the gill-opening. Pectoral spine stout, denticulated; the length of the pectoral fin is about one half of the distance of its root from that of the ventral; ventral fin of about the same length. Vent midway between the root of the pectoral and the end of the vertebral column. The lanceolate shape of the caudal fin is caused by the prolongation of three rays of the upper half of the fin. Dorsal as high as the body; its first ray opposite to the narrow base of the ventral. Anal rather lower, scarcely as high as the tail above. Adipose fin extremely low, like a narrow fold of the skin.

Several specimens were obtained by Mr. Wood-Mason in Tenasserim, the longest being 85 millim. long.

XVIII.—*On a new Species of* Cynolebias *from the Argentine Republic.* By Dr. A. Günther, F.R.S. &c.

Cynolebias robustus.

D. 20. A. 23. L. lat. ca. 35. L. transv. ca. 19.

The height of the body is contained twice and two thirds in the total length (without caudal), the length of the head three

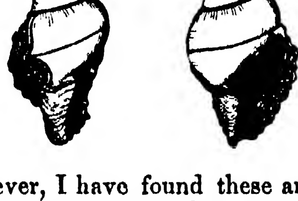
times and one third. Upperside of the head flat, broad, the profile of the neck steeply ascending towards the dorsal fin. Mouth transverse, rather narrow, the maxillary terminating below the anterior margin of the eye. Eyes small. Opercles and upper part of the cheek scaly. Scales of the body rather irregularly arranged. Dorsal and anal fins rather low, the rays being subequal in length and none extending beyond the base of the caudal. Dorsal fin commencing above the seventh ray of the anal fin. Blackish brown; dorsal and anal with small bluish spots.

Three and three fourths inches long. Obtained by Ernest Gibson, Esq., within ten miles of San Antonio, Buenos Ayres. Most of the scales of the side of the abdomen have a minute tubercle on their hind margin. These excrescences are probably developed during a certain season of the year only.

This species is evidently very closely allied to *Cynolebias porosus*, described by Steindachner in the 'Wiener Sitzungsberichte,' 1877, vol. lxxiv. p. 173; but that species is said to be from Pernambuco, has long dorsal and anal fins, and fewer rays in the vertical fins. Our specimen, like that described by Dr. Steindachner, is a male.

XIX.—*On the Genus* Sinusigera, *d'Orbigny.* By Alfred E. Craven, F.L.S. &c.

In the 'Annales de la Société Malacologique de Belgique,' vol. xii. (1877), I published a monograph of this genus, and gave the reasons that made me consider it composed of fully developed shells. The two principal arguments in favour of this view were the great distances from land at which they were often found and the constant dimensions of each species.



Recently, however, I have found these arguments to have been wrong, and that these beautiful and elaborately sculptured shells are, without any doubt, the larval state of various Gasteropods.

Among some soundings obtained by the Rev. R. Boog Watson from Madeira, are several specimens of young shells in which the larval shell or pullus is still complete. These larval shells are what were considered to be *Sinusigeræ.*

Thanks to this gentleman's courtesy, I am enabled to figure one of these specimens, showing the pullus and the continued growth of the shell. In this species the pullus is a *Sinusigera*, intermediate between *S. Huxleyi*, Forbes, and *S. microscopica*, Gray; and in the figure the claw-like lobes from which the shell has continued its growth are easily recognizable. The adult shell of this species is in all probability a *Purpura*, and very likely *P. hæmastoma*, Lamk.

Among these soundings there are also several specimens of another species, the pullus of which is closely allied to *S. cancellata*, d'Orbigny; but with regard to the adult state of this shell there is more uncertainty; it may perhaps prove to be a *Pisania.*

Sinusigera perversa, Craven, is the young of a *Triforis*, or of some allied genus in the Cerithiidæ.

Further observations will no doubt show the shells of the *Sinusigeræ* to be the pulli of many and varied genera. Perhaps also these pulli, when driven far away from shore by currents or storms, pass their existence in this larval state, and never increase or reach maturity, and only those more fortunate in being in shallow waters near shore sink to the bottom and there continue their growth and development. I believe this fact to have been ascertained with regard to some other oceanic forms.

Should this be the case, it would account for the vast numbers of these shells, constant in their dimensions in each species, which are found both on the surface of the open ocean and in a dead state at great depths.

At any rate, the genus *Sinusigera* must now cease to exist, and time only will show the species of Gasteropods of which the various so-called species of *Sinusigera* are the young.

BIBLIOGRAPHICAL NOTICE.

Anatomical Technology as applied to the Domestic Cat: an Introduction to Human, Veterinary, and Comparative Anatomy. By B. G. Wilder and S. H. Gage. 8vo. Pp. 575, 130 woodcuts, and 4 plates. New York and Chicago, 1882.

Ever since the publication of the beautiful and classical work of Straus-Durckheim the anatomy of the cat has attracted the atten-

tion of various naturalists, although Mr. Mivart and Mr. E. T. Newton are, in later times, the only teachers who have selected this easily acquired form as the text for an account of the characteristics of the Mammalia. The present writers give, in their introductory remarks, some very excellent reasons for the selection that they have made, pointing out the abundance, the suitable size, the comparative absence of variation, the accessibility to anæsthetics, and the quietness which appear to be points in favour of the object of their choice. Parts only of the body are here treated of, the viscera and the "arm" being perhaps particularly the objects of investigation; as Professor Wilder is one of the authors, the brain, as might be expected, is especially fully dealt with.

As a handbook of the *technique* of anatomy the book is more complete and useful than any treatise in English with which we are acquainted; the manual of Mojsisovics has, of course, a wider scope. Especial attention may be directed to the notes on the preparation of bones, and the uses and dangers of alcohol; some of the hints to dissectors are excellent; and the remarks on "Pecking" are worth quoting:—

"*Pecking.*—We use this homely word to designate one of the most common and pernicious faults of anatomical beginners—the habit of *aimlessly poking and pinching the parts*, especially while showing them to the teacher or demonstrator. It reminds the observer of nothing so much as the dabbing and pecking which hens inflict upon a piece of meat. The student should bear in mind that a single false cut, and even a pinch in the wrong place, may mar his work beyond repair; he should exercise constant self-control, and *never touch the specimen excepting for a definite and sufficient reason.*"

We may best give an idea of the work by selecting a special chapter; taking that which deals with the brain, we find it to commence by a few general considerations. *Methods of studying the brain* are next discussed; and here we see a first rule which we are glad to be able to indorse: the authors state that, so far as they know, it, among others, has never "been distinctly enunciated heretofore;" but it must of a surety have been forced upon the minds of many teachers. "The arrangements of the solid parts of the brain are more readily perceived and more easily remembered after the relations of the cavities are fully understood." Dealing with an Amphibian brain, which "should be examined first," we have given us a "partial vocabulary" of the separate parts; an "ideal simple brain" is figured and described; and then follow suggestions for the dissection—American students, more fortunate than English, being easily able to compare *Menobranchus* with the frog. Directions are then given for the study of the cat's brain—its removal, weighing, hardening, and injection; after an account of its characters, with illustrative woodcuts, we have four plates from Prof. Wilder's essay in the 'Proceedings of the American Philosophical Society' for 1881; then comes a section headed "Synonyms and References;" and the whole concludes with some interesting remarks on the characters and homologies of the cerebral fissures.

From this very brief sketch it will be seen that the work is hardly for beginners; at any rate, many advanced students will find in it much of value and interest. And, indeed, from what we know of English students, we doubt whether (with all respect for our authors) the younger, at any rate, would not be repelled by it from the study of comparative anatomy. The following sentence (p. 301) is no unfair example of their style:—

"DUCTUS STENONIANUS.—Stenon's duct, duct of the parotid gland (fig. 87). It extends cephalad from the cephalic edge of the gland along the ectal surface of the masseter muscle, nearly directly toward the angle of the mouth. When near the edge of the lip it penetrates the cheek, passing entad of the facial vein (fig. 87, V. facialis). It opens on the mucous surface of the cheek opposite the most prominent cusp of the last præmolar (fig. 57)."

We are far from saying that we look with any thing like dissatisfaction on the use of technical terms, that we do not recognize their value, or the weight of the arguments brought by the present authors in defence of their treatment of the subject; nor do we fail to recognize the important services rendered to morphological and descriptive anatomy by Barclay and Owen, and those who have followed these masters; nor do we say that we do not sympathize with the remarks made in the volume before us rather than with those of quite an opposite tendency which have been made by Mr. Lyman in his Introduction to the Ophiurids of the 'Challenger' expedition; but we recognize just as much that strong meat is not for babes, that the commencing zoologist, who should also be being introduced to the elements of botany, has of necessity quite enough technical terms to learn, and that it is the business of the teacher to relieve him wherever and whenever he can. In other words, the investigation and the discussion of morphological and zoological problems is aided by the appropriate use of technical and substantive terms, in place of periphrases and adaptations; but early study, and a knowledge of the elementary characters of natural objects are most successful when the objects themselves are veiled as little as may be in terms which distract the attention and load the memory.

To those who can bear with them, we are glad to be able to introduce this work.

MISCELLANEOUS.

The Migrations of the Aphis of the Red Galls of Ulmus campestris (Tetraneura rubra, *Lichtenstein*). By M. LICHTENSTEIN.

THE new theories upon the biological evolution of the Aphides, to which I have been led by my long-continued investigations of those insects, although strongly contested at Paris, have made way in

other countries, and begin to be generally accepted, having been confirmed by such observers as Targioni-Tozzetti, Kessler, Buckton, Horvath, Riley, &c. Nevertheless the facts supporting those theories are still scattered; for, although it is indisputable that the *Phylloxera* of the oak, of Boyer de Fonscolombe, passes from *Quercus coccifera* to *Quercus pubescens*—although Targioni was able to show to his colleagues at Florence *Phylloxera florentina* passing from *Quercus ilex* to *Quercus sessiliflora*—although Planchon, Signoret, Cornu, Riley, and twenty more have seen *Phylloxera vastatrix* pass from the leaf-galls to the roots of the vine, the history of the metamorphoses of the other Aphides has not been much advanced; and it is a very curious thing that the biological evolution of the genus *Phylloxera* and of an *American* species of that genus is much better known to us than that of the Aphides of the poplar or the elm, although they occur by thousands of millions every year upon those common trees, defying the unfortunate entomologists who have sought to trace them ever since the days of Réaumur and Linné, and even long before them.

Various indications had indeed led me to suppose that several of these Aphides must, like *Phylloxera*, have a phase in their lives when they become radicicolar. Experiments in feeding the Aphides originating from the winged forms issuing from the galls of the *Lentiscus* upon the roots of grasses, made at Montpellier by M. Courchet and myself, were partially successful. Further, I had found upon these same roots the winged pupiferous form of *Aploneura lentisci*, which is very easy to recognize, because it is the Pemphigian or gall-aphis that carries its wings flat, like *Phylloxera*; but as regards the Aphides of the galls of the poplar and elm nothing has hitherto been discovered.

The Aphides which form these galls belong to three different genera:—

> *Pemphigus*, represented by about 25 species;
> *Schizoneura*, represented by 9 or 10 species; and
> *Tetraneura*, of which we know only 2 species.

In deciding to trace these last two Aphides, which are called *Tetraneura ulmi*, forming a smooth green gall upon the leaves of the elm, and *Tetraneura rubra*, Licht., which forms a bright red rugose and curly gall, I had more chance of attaining my object than if I had attacked genera with more numerous species, in which it would have been very difficult for me to refer the subterranean to the corresponding aerial species. Moreover the course was to some extent cleared. At the end of the last century (1770) Von Gleichen had carried on *day by day* for eight years observations upon *Tetraneura ulmi* during its aerial evolution without discovering any thing; in resuming these investigations after one hundred years I had discovered under the bark of elms the female of this species, with its encysted egg in its body. Prof. Kessler, of Cassel, made a step in advance of this, and found the winged pupifer bringing the sexual

forms onto the elms, and was enabled to figure this form and that of the males and females; but he did not know whence it came, nor does any one yet know.

But this present year, vigorously assisted by my young pupil and collaborator, M. Franz Richter, I have examined thousands of the root-tufts of all our wild grasses; and among numerous examples of *Pemphigus* and *Schizoneura*, the history of which will come later on, we found on the roots of *Triticum repens* a colony of *Tetraneuræ* with the winged forms, easily recognized by the single vein in their hind wings, whereas the other Pemphigians have two. Placed carefully in tubes, these winged forms furnished sexual forms; they are therefore the *pupiferous* form. We set to work to examine the trunks of the elms growing in the neighbourhood, and under their bark we found the same winged forms busy furnishing the trees with the same sexual forms that the Aphides collected from the grass-roots had produced in the tubes. We compared these insects with the figures that Kessler has given of *Tetraneura ulmi*; the antennæ were different, and resembled those of *Tetraneura rubra* of the *emigrant* form, *i. e.* that which quitted the red galls between the 1st and 15th of June.

Hence there was no more doubt, and the evolution of the red galls of the elm has no longer any gaps.

The fecundated egg passes the winter under the bark encysted in the body of the female.

This egg hatches in the spring; and there issues from it the *foundress pseudogyne*, which forms its gall in *April*, and surrounds itself in *May* with a numerous progeny of young animals born alive.

The *whole* of this progeny acquires wings and becomes the *emigrant pseudogyne*, which flies away and settles itself upon grasses, especially upon *Triticum repens*. This emigration takes place in June.

Here this form produces living young, which pass to the roots, where they live as *gemmiparous pseudogynes*, continue wingless, and deposit in July and August living young, which are destined to acquire wings.

In fact, in September and October, this fourth form, which is the *pupiferous pseudogyne*, issues from the ground in the winged state, and returns to the trunks of the elms, where it produces sexual individuals, which copulate, after which the female goes to hide herself and die beneath the bark, retaining in her body the *single* fecundated egg, for which the dried skin of the mother forms a double envelope.

Each phase, even the sexual, undergoes four moults before becoming capable of giving origin to the succeeding phase by gemmation, or of copulating. Including the sexual forms, therefore, this insect presents twenty-four different forms (sixteen in the larval or *pseudogyne* state and eight in the sexual). These forms are in general easy to distinguish by the number of joints in the antennæ, which vary from four (in the founders) to five and even six in the winged forms.—*Comptes Rendus*, December 4, 1882, p. 1171.

The Metamorphosis of Penæus. By W. K. Brooks.

Scarcely another fact in morphological science, standing alone, exceeds in interest the discovery that *Penæus*, a Decapod, passes through a Nauplius stage.

Those familiar with the literature of the subject will recollect that Fritz Muller kept under observation until it changed into a Protozoea a Nauplius which he captured at the surface of the ocean.

He also secured, in the ocean, a very complete series of larvæ, through which he identified his Protozoea with a young Macrouran with the characteristics of the genus *Penæus*.

He did not rear the Nauplius from a *Penæus* egg; nor did he actually observe the transformation into the young *Penæus*. Certain over cautious naturalists have therefore refused to accept his conclusions until more conclusive proof should be furnished.

A number of stages in the development of *Penæus* have been figured and described by Claus; but as he also relied upon surface-collecting, his evidence is open to the same objection.

Although I have shown, by tracing from end to end the life-history of *Lucifer*, that this Macrouran undergoes a series of changes almost perfectly parallel to those which Fritz Muller describes in *Penæus*, it is still desirable, as a matter of history, and in order to set at rest those critics who refuse to give any weight to deductive reasoning in morphology, to trace the life-history of *Penæus*, by actually witnessing the changes.

I have been able this summer, at the marine laboratory of the Johns Hopkins University, to obtain the youngest Protozoea stage of *Penæus*; the stage which Fritz Müller actually reared from the Nauplius. I have had the good fortune to rear this larva in the house, and to witness in isolated captive specimens every one of the five moults between the first Protozoea and the young *Penæus*. During June and July, the breeding-season, the mature females cannot be found inside the Sounds of our coast; and as our b[illegible] too small for outside work during these windy months, I h[illegible] been able to secure the eggs or Nauplii; but this, the only gap in my series, is filled by Fritz Muller's observation. The whole metamorphosis of *Penæus* has therefore been actually witnessed, and there is no longer any room for criticism.

Protozoeas apparently identical with the youngest one figured by Müller, and which a comparison with *Lucifer* shows to be in the "first Protozoea" stage, were captured at the surface of the inlet by the hand-net.

They were carefully drawn and measured, and were then placed in tumblers, one in each tumbler, and were kept thus isolated and under observation until they assumed the characteristics of the genus *Penæus*, which they did after five moults.

The first Protozoea has an ocellus, a very short rostrum, and traces of the compound eyes, which are not yet movable. The first and second antennæ are Nauplius-like; and the biramous second antennæ are the chief organs of locomotion. The labrum has a short spine;

the mandibles are stout cutting-blades, with no trace of a palpus, or of the swimming-branches of the appendage. The first maxilla is small and jaw-like, while the second is long and slender, with a very small scaphognathite. There are three pairs of maxillipeds, all of them biramous. The first pair are large, fringed with long swimming-hairs, and they are efficient swimming-organs. The second pair are much smaller and of less functional importance; and the third pair are rudimentary and scarcely visible. The long slender hind body shows only very faint traces of a division into segments; and no ganglia could be made out. The tip of the abdomen forms a forked telson, with seven pairs of plumose hairs—one short one on the inside edge, another short one on the outside edge, and a terminal row of five much longer ones, the middle one being the longest of all.

After moulting, the "second Protozoea" is essentially like the first, the chief differences being that the compound eyes are now movable, and the hind body is sharply divided into segments. No joint as yet separates the telson from the sixth abdominal segment; but, with this exception, all the segments of the hind body are now well defined.

In the species which was studied, probably *Penæus brasiliensis*, the rudimentary thoracic and abdominal appendages described by Claus at this stage were not visible. I did, however, find a few specimens of another species which agreed in this respect with Claus's figure.

After the next moult the larva becomes what I have called in my paper on *Lucifer* a "Protozoea with preparations for the Schizopod stage."

It might, perhaps, be spoken of as a Zoea. The ocellus is still present, although the compound eyes are large and quite movable.

The rostrum is lengthened. The two pairs of antennæ retain the Nauplius characteristics.

The mandible has no trace of a palpus; and the metastoma consists of a pair of broad flat plates, separated from each other on the middle line, and placed in the same series with the other appendages.

The maxillæ and maxillipeds are as they were at the stage before, except that the third pair of maxillipeds are a little larger although they are still rudimentary.

The five thoracic somites are now cemented together; and each bears a pair of buds or pouches, the rudimentary appendages.

The telson is separated by a joint from the sixth abdominal segment; and the latter carries a pair of rudimentary swimmerets. There are no traces of appendages on any of the other abdominal segments, although all the ganglia are conspicuous and well developed. The halves of the fork of the telson diverge from each other a little more than they did during the earlier Protozoean stages.

After the next moult the animal reaches the Schizopod stage, so far as the anterior half of the body is concerned, although the abdo-

minal appendages are still absent. The ocellus is still present, as in the first Protozoea; but the character of the antennæ has changed completely. The ear has appeared in the basal joint of the first antennæ, and contains diatoms and other foreign bodies. The two-jointed basal portion of the second antennæ carries a short pouch, the rudimentary flagellum, and a long scale with plumose hairs and a single spine.

The palpus has appeared on the mandible. The exopodites of all five pairs of legs are large, and are now, with the swimmerets, the locomotor organs. The endopodites of the fourth and fifth pairs are somewhat less developed than those of the first, second, and third pairs, which now end in chelæ. The abdomen carries only one pair of appendages, those of the sixth segment; but these are now larger, and are used in swimming.

The tip of the telson is now almost square, with a very slight notch in the middle line.

After the next moult the chief change consists in the formation of the first five pairs of abdominal appendages. The endopodites are absent; and the whole appendage is rudimentary, and is not used for locomotion until the next stage.

After the next moult the animal reaches the *Penæus* stage. The scale of the antennæ becomes broad and triangular; the flagellum is greatly elongated and is divided into twelve joints. The mandibular palpus is greatly enlarged, and covers up the bases of the antennæ. The exopodites disappear from all five pairs of legs; and the abdominal appendages are now functional, although the endopodites are still absent.

This stage is reached by the first Protozoea in about three weeks: and all the changes have been actually witnessed in isolated captive specimens.

Our boat is too small for work outside during the windy months of June and July; and as the ripe females do not come into the inlets and sounds, I have not been able to obtain the eggs or the newly hatched young: but this is the less important, as Fritz Müller reared his "first Protozoea" from a *Nauplius*, so that we now have the entire metamorphosis from actual observation.—*Johns Hopkins University Circulars*, November 1882, p. 6.

On the Growth of the Molluscan Shell. By H. L. Osborn.

The structure of the molluscan shell has been studied by means of sections of adult shells by Carpenter and others; and they have found that it presents an outer membranous horny epidermis and an internal stony portion. Such a method could not give any idea of the actual process of shell-formation; a knowledge of this could be gained only by study of the first steps. To this end edges of the shell were snipped away, and a thin glass circle thrust between the animal and its shell, care being taken to prevent injury to the mantle. After the lapse of twenty-four hours the shell was

opened and the glass circle carefully examined; others were allowed to remain two days, three days, or for periods of weeks.

In twenty-four hours it was found that a film had been left upon the circle; in forty-eight hours this film was plainly stony. The earliest traces of this film, when treated with colouring-reagents, stain: but when treated with acids show no traces of lime nor any evidences of structure; it is simply a structureless membrane. Later films, when treated with acetic acid, present the appearance of a tessellated pavement, and when examined with the polariscope and not treated with acetic acid show beautifully the presence of lime.

It would thus appear that the epithelium of the mantle pours out a secretion of horny matter, which forms the epidermis, that this secretion holds lime in solution, and that from this the stony internal portion of the shell is formed. Experiments were successfully made upon the shells of the oyster and *Pinna* and several other lamellibranchs: and some gasteropods were tried, but thus far in vain.—*Johns Hopkins University Circulars*, November 1882, p. 7.

Lantern-slides for Biological Lectures.

Many of those who are engaged in lecturing to large classes and to popular audiences on the elementary facts of biological science have felt the want of a good series of lantern illustrations, which should enable them to some extent to dispense with the large and expensive diagrams that are now so generally used.

A large series of this kind, illustrating all the more important physical experiments, has been issued by Messrs. F. York and Son, 87 Lancaster Road, Notting Hill, W.; and arrangements have now been made with the same firm for bringing out a biological series under the supervision of Dr. Andrew Wilson and Mr. William Lant Carpenter. It will contain illustrations of typical examples, with the life-histories when possible, of the lowest forms of animal and vegetable life (especially of those bearing on the Germ Theory), the various classes of the Protozoa, the Coralligena, Echinoderms, Mollusca, and Entozoa, the different phases of insect life, and the elementary facts of vegetable physiology. An excellent series illustrating human anatomy and physiology is already in existence; and there is also a little-known German series of zoological slides, which is far less extensive, however, than that which it is proposed to issue. Fossil forms will be illustrated in their proper places with respect to living ones; and preference will be given to the illustration of a few well-selected types rather than to minute differences of detail.

It is hoped that the knowledge that such a series is in preparation (for issue in August or September) may save the construction of some diagrams, and may also induce those interested in the subject to suggest good figures suitable for photographic reduction.

Several well-known teachers and lecturers have expressed their warm approval of the scheme.

Communications may be addressed to Dr. Andrew Wilson, 110 Gilmore Place, Edinburgh, or to Mr. William Lant Carpenter, 36 Craven Park, Harlesden, N.W.

On a Starfish from the great Depths of the Atlantic, furnished with a Dorsal Peduncle. By M. E. PERRIER.

Among the Stellerida collected during the expedition of the 'Travailleur' in 1880 there are two individuals of a species of Starfish* which present the perfectly exceptional character of being furnished with a dorsal peduncle, exactly comparable, as to its position, to that which supports and fixes to the ground the young Comatulæ and the adult Crinoids of all the other families. While the Crinoids, which are evidently the most ancient of the Echinodermata, are all attached, at least during their youth, the Echinodermata which form the other classes of that subkingdom are free during their whole lives; and it would be particularly interesting to find in that class, which we have every reason to consider the most ancient after that of the Crinoids, traces of a mode of existence which was general among the latter animals, namely fixation to the ground. Some characters of the Starfishes which we have now to speak of seem to indicate that the dorsal appendage with which they are furnished is really the homologue of the peduncle of the Crinoids.

Our two Starfishes, which we propose to name *Caulaster pedunculatus*, are of different ages. The larger one has a radius of only 5 millim. to the extremity of the arms, and of 3 millim. to the summit of the interbrachial arch. In both the summit of this arch is occupied by a sort of fissure furnished with papillæ, separating the marginal plates which belong to one arm from those belonging to the other. The fissures are prolonged upon the disk, on the dorsal surface, each by a double series of spines. These rows of spines converge towards the base of the dorsal appendage. The marginal plates, which are not very visible, only form a single row, as in *Ctenodiscus*; there are five of them to each arm; the madreporic plate, which is tubercular, is enclosed in one of the interbrachial fissures. The arms are short, strongly recurved over the disk, and each terminated by three long spines; the ambulacral tubes, destitute of suckers, are arranged in two series; there are not more than eleven pairs. The dentary plates have the form of simple scales, uniting at their free extremity to be produced into a sort of unpaired conical tooth. The dorsal integument is soft; we cannot distinguish plates of any kind upon its surface. The dorsal appendage, 2 millim. long, and consequently nearly as long as the

* These two starfishes were obtained off the north coast of Spain, one at 1900, the other at 2650 metres.

smaller radius of the animal, is cylindrical and flexible, and its surface is granular. In the larger individual there was nothing to enable us to judge of its true nature; but in the younger of the two individuals of *Caulaster* that we have been able to examine, other characters of more importance from the morphological point of view are superadded to those above indicated. Thus at the base of the dorsal appendage there are four large calcareous plates arranged in a cross, and each bearing a small spine; these plates are arranged nearly in the direction of the arms: a fifth plate alternating with two of them and opposite to the madreporic plate, evidently forms part of the same cycle; and five other smaller plates are placed in the angles left free by the five plates of the first series. We cannot help being struck with the absolute resemblance of these ten alternating plates to those which form the periproct of the Sea-Urchins, which Lovén has compared to those forming the calice of the Crinoids—an opinion that we shall have to discuss shortly. The identity of arrangement of the dorsal plates of *Caulaster* with those of the calice of the Crinoids is evident; the presence in the centre of the double cycle which they form of an appendage resembling the peduncle which occupies the same place in the Crinoids marks this resemblance still more strongly; the homologies of the latter parts are at once established; and we thus find that, by means of *Caulaster*, a close bond of union is established between the Crinoidea and the Stellerida. The character here indicated will appear the more significant because in *Leptychaster*, discovered during the 'Challenger' expedition, the young starfishes, which are developed in a special pouch of their mother, are attached to the walls of this pouch by the centre of their dorsal surface. On the other hand, the rosette of plates which surrounds the dorsal appendage is an embryonic character, since it disappears with age; and this is precisely what ought to take place if we regard the Stellerida as a form of Echinodermata derived from and higher than that of the Crinoids.

The young *Asteriæ* and *Brisingæ*, as established by Lovén and myself, also present dorsal plates, arranged, at first, like those of the calice of the Crinoidea; we have demonstrated that, in *Brisinga*, the plates of the first series become the odontophores; these plates cease to be visible externally in *Caulaster*. The question is whether they really disappear in this animal, which would lead us to adopt a new type of development among the Stellerida. *Caulaster* is evidently allied to the *Ctenodisci*; in the latter there exists a slight tubercle, which seems to us to be homologous with the dorsal appendage in *Caulaster*; and perhaps we might also compare with it a projecting knob which in *Astropecten* occupies the place where the anus occurs in other starfishes.—*Comptes Rendus*, December 26, 1882, p. 1379.

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XX.—*On the Cyclical Development and the Relationships of the Siphonophora.* By Dr. CARL CHUN *.

[Plate V.]

I. *The Cyclical Development of* Monophyes primordialis, *Chun.*

In the year 1853 Leuckart † ascertained the remarkable fact that the appendages united in groups on the stem of the Diphyidæ break loose from each other, and lead a free existence separated from the colony. A whole series of supposed distinct species distributed under the genera *Eudoxia* and *Ersæa* (the "monogastric Diphyidæ") thus proved to belong to the developmental cycle of the Diphyidæ. When afterwards attention was called by Huxley ‡, Pagenstecher §, and Claus ‖ to certain very simply constructed small Siphonophora with only one nectocalyx, which, following Claus, we

* Translated by W. S. Dallas, F.L.S., from the 'Sitzungsberichte der k. preuss. Akademie der Wissenschaften,' 1882, pp. 1

† 'Die Siphonophoren.

‡ 'The Oceanic Hydrozoa,'

§ "Eine neue Entwicklungsweise bei Si

Zool. xix. p. 244.

‖ 'Schriften zoologischer Inhalts. II. Die Gattung *Monophyes*, Claus, und ihr Abkömmling *Diplophysa*, Gegenb.,' Taf. iv.

may designate Monophyidæ, and the same clustered arrangement of the polymorphous individuals was detected upon their stems, it seemed probable that in these also the groups would separate. Claus demonstrated in his interesting memoir that the monogastric colonies described by Gegenbaur under the name of *Diplophysa* really represent the freed sexually mature offspring of *Monophyes*.

Consequently, so far as our knowledge of the cyclical process of development of the Monophyidæ and Diphyidæ on the one hand, and on the other of the highest Siphonophora, namely the Velellidæ, extends, we were justified in assuming that the brood of the *Eudoxiæ* and *Diplophysæ*, like the Medusæ budding and separating from the Velellidæ, namely the *Chrysomitræ*, in their turn furnish the polymorphous nurse-generation.

To my astonishment, however, the study of a new species of *Monophyes* showed me that the cyclical development of the Siphonophora manifests still further complications.

In briefly describing now the structure and development of *Monophyes primordialis*, which is the name I give to this new species, I only follow the course which my investigation took.

Among the rich pelagic fauna of Malaga with which the use of the surface-net furnished me I often remarked a small Siphonophoran stock which looked remarkably like a *Diphyes*. It is true that in all the specimens a second lower nectocalyx was wanting, a circumstance which, however, did not much strike one at first, seeing that, when at all roughly treated, both nectocalyces of the Diphyidæ easily become detached. But although I proceeded most carefully in their capture, I never succeeded in detecting a colony with the missing second nectocalyx. As, further, it was impossible to discover any point of insertion for the latter, I arrived at the conclusion, which was afterwards confirmed, that I had to do with a Monophyid of very aberrant structure. At first I regarded it as new, but subsequently ascertained that two excellent old observers, Will and Busch, had observed and figured this Siphonophoran stock. Will * discovered it at Trieste, and, like Busch † and later observers, regarded it as a *Diphyes*. He named it *Diphyes Kochii*; and under this name it was also more accurately described by Busch, with the express remark that he had been no more successful than its discoverer in the

* 'Horæ Tergestinæ,' 1844, p. 77, Taf. ii. fig. 22.

† 'Beobachtungen über Anatomie und Entwickelungsgeschichte einiger wirbellosen Seethiere,' 1851, p. 46.

detection of the second nectocalyx. As Busch describes a form evidently identical with *Diphyes Kochii* as *Muggiæa*, in consequence of supposed differences, I combine the names selected by the first observers, and designate the Siphonophoran as *Muggiæa Kochii*.

As regards its structure, which I afterwards had the opportunity of examining more accurately in Naples, the elevated flask-shaped nectocalyx exactly resembles the nectocalyx of a Diphyid (fig. 2). It is furnished with five wing-like edges, two of which are more considerably developed towards the margin of the bell and bound a funnel-shaped space, within which the stem with its appendages can be retracted. The nectosac, consisting of transversely striated spindle-shaped muscle-cells, lines the subumbrella, and terminates at the margin of the bell in a very contractile velum. On the dilated side of the nectocalyx, above the funnel-shaped gelatinous mantle [*hydrœcium*], we easily observed the so-called fluid receptacle [*somatocyst*, Huxl.], with its oil-drop, an organ which has received the most various interpretations, but, in my opinion, without the right one having been hit upon. I regard it as a hydrostatic apparatus, destined, by means of the specifically lighter oil-drop, to present in some degree a counterpoise to the heavy stem with its appendages, and to keep the nectocalyx in an approximately vertical position. From the base of this fluid- or oil-receptacle originate four vessels (overlooked by Will and Busch), which are situated beneath the musculature of the subumbrella, and open into an annular vessel close to the margin of the nectocalyx. Two of these vessels run upwards on the side-walls, then bend round in an elegant curve, and descend towards the margin; a third attains the summit of the subumbrella, and opens into the annular canal opposite to its place of origin; while the corresponding fourth vessel forms only a very short branch of union between the latter and the issue of the above-mentioned [annular] vessel. Both the vessels and the fluid-receptacle open into the contractile stem of the whole colony [*hydrosoma*] with its polymorphic groups of appendages. In general this is not very long; I have not observed on it more than twelve groups of individuals. The latter regularly diminish in size from the base of the stem to its distal extremity. Originally they consist of four buds lined with endoderm, the largest of which develops into a stomachal sac, while two smaller ones placed above it represent the rudiments of the bract and of the genital nectocalyx; the fourth, which is situated at the base of the stomachal sac, and is early much divided at the surface, becomes differentiated into the tentacle with the urticating

batteries. Without going into detail upon the development of these buds, I will only mention that the rudiment of the bract becomes flattened, and, curving like a sickle, begins to grow round the stem. Its endodermal cavity forms the liquid-receptacle, and the lateral parts, which grow out into wings, embrace the genital nectocalyx. In the lowest groups of individuals therefore we remark first of all the mobile stomachal sac with the ectodermal cell-pad at its base, and its yellowish-red mouth often dilated in the shape of a funnel; further, the tentacle, with its amœboidally movable ectodermal cell-processes, and the kidney-shaped urticating batteries, of a bright yellow colour, attached to long accessory threads; and finally the genital bell, with its central manubrium, forming the sexual products and the four vessels opening into an annular canal. The umbrella of the genital bell grows rapidly to a considerable size, and, assisted by a velum, begins to perform pumping movements, until finally the group separates from the stem at the point of insertion of the bract, in order to lead an independent existence for a considerable time.

These sexually maturing monogastric colonies (fig. 3) also have not escaped the attention of the observers Will and Busch, who have been already repeatedly mentioned, although certainly they did not recognize their relations with *Muggiæa*. Will * describes a Siphonophore under the name of *Ersæa pyramidalis* which is evidently identical with the *Eudoxia Eschscholtzii* so accurately studied by Busch †. *But* Eudoxia Eschscholtzii *represents the sexual generation of* Muggiæa. From the most highly developed individual groups of *Muggiæa* it differs externally only in the form of the bract, which has become considerably thickened, and, as the last indicatio of its wing-like dilatation, exhibits two angles, which extena from the apex towards the genital calyx. The latter has attained its full size, shows in transverse section four wing-like edges of unequal size, and always allows the four vessels with their annular canal, which were overlooked by Busch, to be recognized. That the *Eudoxiæ* are of separate sexes and produce semen and ovum in the manubrium, representing the stomachal peduncle of a Medusa, we first learned from Busch. He further called attention to the fact that, besides this nectocalyx, a second is produced, the significance of which, however, was not clear to him. Leuckart ‡ and Gegenbaur § first

* Horæ Tergest. p. 8, Taf. ii. fig. 17.

† *Loc. cit.* p. 33, Tafs. iv. and v.

‡ *Loc. cit.* p. 47.

§ "Beiträge zur näheren Kenntniss der Schwimmpolypen," 1854, Zeitschr. f. wiss. Zool. Bd. v. p. 290.

demonstrated in different *Eudoxiæ* that this second nectocalyx represents an accessory structure, destined in course of time to replace the first large one. I have detected the first rudiment of this second calyx in the form of a small bud (fig. 2, *x*) even in the groups still adhering to the stem of the *Muggiæa*. It seemed to me of interest to obtain an answer to the question whether a regular succession of new genital nectocalyces takes place, and also whether during this change the sex of the *Eudoxiæ* is altered. Without describing the precautions by means of which I succeeded by suitable aeration and nourishment in keeping the delicate colonies alive for some days, I may state that, besides the above second accessory bud, the foundation of a third, and, as I succeeded in ascertaining in one case, also that of a fourth bud became developed. As soon as the oldest calyx has emptied out its genital products, which usually takes place while it is still connected with the *Eudoxia*, it is displaced and pushed off by the rapidly growing reserve calyx, which then in its turn undergoes the same fate. But the reserve calyces always produce the same sexual products as the first calyx; no change of sex therefore takes place. As I have been able to confirm Leuckart's statements with regard to the change of the replacement-nectocalyces in *Eudoxia campanula*, and as further similar replacement-buds have been observed in all carefully investigated *Diplophysæ* and *Eudoxiæ*, we may assert generally *that the* Eudoxiæ, *without alteration of sex, successively produce a brood of medusiform sexual animals by a process analogous to strobilization.*

If we examine the genital manubrium when filled with mature ova, we observe in them a peculiar phenomenon. They lie between the ectoderm and endoderm, of which the latter almost entirely clothes them, leaving free only a small part of the surface which is in contact with the ectoderm. At this spot we always find the large peripherally placed nucleus, with its nucleolus. Between the ectoderm and the part of the periphery of the ovum which is not covered by the endoderm, some fluid collects, in which from two to three direction-vesicles are to be detected. Müller, who first called attention to this peculiarity, regarded this arrangement as a micropylar apparatus. I cannot, however, agree with him in this view, as I could neither find an aperture in the ectodermal lamella, which is sometimes dilated and thin, nor meet with fecundated ova in the genital manubrium. What Müller regards as spermatozoa that have penetrated are evidently only the direction-vesicles. The nucleus, with the surrounding plasma, is usually overflowed by the neighbouring ectoplasm, so that

it is placed at the bottom of a pit-like depression. But if we observe the perfectly mature ova, we find that the nucleus gradually arches up and the depression disappears, until finally the nucleus, enveloped by the adjacent plasma, projects above the periphery of the ovum as a lenticular elevation. The delicate ectodermal envelope is at the same time also a little pushed forward and stretched. In a short time the convexity disappears rapidly, and the nucleus draws back again so far that a pit-like depression is again produced. In this way, then, pumping movements are executed at one part of the surface of the ovum pretty regularly, about twice in a minute, their purpose evidently being to burst the thin ectodermal envelope and to render possible the exit and fertilization of the ovum. As a matter of fact, indeed, we find that the ova are evacuated from the manubrium singly, and not simultaneously.

To judge from our previous knowledge of the development of the Siphonophora, we should expect that from the fertilized egg of *Eudoxia Eschscholtzii* the *Muggiæa* would originate. I was therefore not a little surprised when, in my pelagic captures, I met with an elegant Siphonophore which at the first glance showed itself to be a true *Monophyes*, and yet presented stomachal sacs and urticating batteries which, even by the most careful examination, were not to be distinguished from those of *Eudoxia Eschscholtzii*. As regards the organization of this smallest and most simply constructed colony among all the Siphonophora, which has been seen by no previous observer, it consists essentially of a medusiform nectocalyx, a stomachal polyp, and a tentacle (fig. 1). The calyx is cap-shaped and of laterally symmetrical form. The dome of the umbrella appears drawn out into a lappet and rounded off. Close to the place of insertion of the other appendages two gelatinous pads arise as the first indication of an incomplete sheath. Four vessels, originating from the base of the fluid-receptacle, which traverses the umbrella obliquely and is furnished with an oil-drop, supply the subumbrella, finally opening into an annular canal placed upon the velum. I have already indicated that the stomachal sac and the tentacle exactly agree with those of *Eudoxia Eschscholtzii*. Only the youngest examples, however, are so simply constructed as the *Monophyes* just described; a further complication may be observed in somewhat older specimens. Thus the stomachal sac and the tentacle are somewhat removed from the base of the fluid-receptacle, and communicate with the latter by means of a contractile portion, the first indication of the stem. On the other hand new rudiments of buds make

their appearance on this little stem quite close to the fluid-receptacle, and, indeed, first of all a bud of considerable size above (towards the apex of the umbrella), and afterwards, opposite to this, a group of four buds (fig. 5). While the first developed bud, as soon appears to be the case, represents the rudiment of a nectocalyx, we are struck, in the group of four buds, with a development identical with that of those groups of buds which we have already had occasion to mention on the basal part of the stem of *Muggiæa*. In point of fact we cannot avoid the notion that the four buds represent the constituents of a *Eudoxia Eschscholtzii*, the stomachal sac, the tentacle, the bract, and the genital calyx.

But how are we to explain the enigmatical phenomenon that, by two so perfectly different forms as are represented by the *Muggiæa* and *Monophyes primordialis*, there are formed bud-rudiments which perfectly harmonize in their further development, and in both cases grow up into *Eudoxia Eschscholtzii*? The solution of all the problems which thus press themselves upon us is no less susprising. From the rudiment of a nectocalyx placed at the origin of the stem of *Monophyes primordialis* is produced the five-angled nectocalyx of the *Muggiæa*. Muggiæa Kochii *consequently does not represent a distinct species, but it is produced by gemmation from* Monophyes primordialis, *and then, carrying with it the parent stem and the future* Eudoxia-*groups, separates from the parent animal and leads a free existence.* In fig. 4 I represent a stage (captured in freedom) which clearly demonstrates the connexion between *Muggiæa* and *Monophyes*. The nectocalyx of the former has already acquired the pentagonal form, and shows distinctly the characteristic course of the vessels. The aperture of the calyx is turned away from that of the *Monophyes*-calyx, so that the two perform brisk pumping movements in opposite directions. In almost all the subsequently observed cases (and by rearing the *Monophyes* I have six times succeeded in getting the calyx of the *Muggiæa* to grow to half the size of the *Monophyes*-calyx) the calyces were arranged in the same direction. The stem is already of considerable length, and, besides the terminal stomachal sac with the tentacle, shows the rudiment of another *Eudoxia* group. But if we place the organism in a watch-glass with abundance of water and observe the two calyces engaged in performing their very lively pumping movements, we sometimes succeed in directly convincing ourselves of their separation, inasmuch as generally after a violent pumping movement on the part of one of the calyces the delicate uniting part of the stem tears away, and the two then continue to move independently.

This also explains why in fishing we often meet with the calyces of *Monophyes* destitute of all appendages, besides the isolated sexual calyces of the *Eudoxiæ*. After its separation the calyx of the *Muggiæa* grows rapidly, and attains about three times the size of the *Monophyes*-calyx. But it is not only upon the almost fully developed calyx of the *Muggiæa* just described that the connexion of the two generations may be demonstrated, but even in the insignificant globular bud on close examination the course of the vessels characteristic of the developed calyx already makes its appearance distinctly. A glance at fig. 5 shows how the tissues of the stem take part in the construction of the bud, how the ectoderm passes continuously into the external wall of the bud (the umbrella was even previously formed by an ectodermal invagination), while the endoderm produces, by a dilatation, the first traces of the fluid-receptacle and the vascular lamella, in the latter of which the vessels take the course typical of the developed *Muggiæa*.

The fact that by the side of a small cap-shaped nectocalyx a second one so totally different in form and size is budded forth, destined to separate from and perform the same function as the primary calyx, is unique among the Cœlenterata. We find indeed on the stem of the Siphonophora the most various polymorphic appendages; but the different form is always determined by a different function; the medusiform locomotive is of different construction from the medusiform genital nectocalyx budded from the same stock. But how are we to explain the fact that in this case two calyces intrusted with the same function, namely the locomotion of the stock, acquire such a different habit? I know of no other answer to give to this question than that the small cap-shaped *Monophyes*-calyx suffices for the transportation of the single stomachal sac with the tentacle, but that with the elongation of the stem and the increase of the individual groups it becomes necessary, by a larger and more slender calyx, which can cut through the water easily, to weaken the resistance which is opposed to rapid locomotion by the long drawn-out trailing stem with its appendages. That the Diphyid-like calyx of the *Muggiæa* fulfils such requirements will be the experience of any one who attempts to take out the little stock as it shoots through the water with the rapidity of an arrow.

But although I believe that I have proved as an established fact that the cyclical course of development of these lowest Siphonophora consists of three generations, scientific method requires the proof that *Mono* [illegible] originates from the ova of the *Eudoxia* budded off from the

Muggiæa. Although the investigation is attended with several difficulties, arising from the minuteness and transparency of the tiny ova, and, further, from the circumstance that we can very seldom find at the same time male *Eudoxiæ* with perfectly mature pin-shaped spermatozoa and female nectocalyces which show themselves to be filled with fertilizable ova by the characteristic pumping movements of the plasma surrounding the nucleus, I have nevertheless, after several vain attempts, finally succeeded in obtaining an artificial fecundation, and furnishing the proof that from the ova of the *Eudoxia* a ciliated embryo is produced, which grows into the *Monophyes*. Seven mature ova which were contained in the manubrium of a genital calyx, and one of which was just beginning to issue from the ruptured ectodermal envelope, I placed on the 23rd September in a vessel which swarmed with spermatozoa taken from a male manubrium. As from the scantiness of the material my special object was to rear the later developmental stages, I forebore the observation of the first phenomena of segmentation. In the warm season they must take place rapidly; for as early as the next day I found to my delight seven free-swimming embryos. The youngest represented a spherical planula, with thin ciliated ectodermal cells and large polyhedrally flattened endodermal cells occupying the whole interior space. It quickly begins to assume an oval form, and at one pole differentiates yellowish-red pigment. This represents the future buccal pole, or, to speak more exactly, the spot at which the buccal aperture of the stomachal polype breaks through. During the rotating locomotion it is directed backward. At one side of the pigmentless pole, which is in front as the animal advances, an ectodermal invagination is produced, the rudiment of the subumbrella of the nectocalyx. Below this the body-wall swells up in the form of a bud, from which, by various repeated sinuations, the tentacle takes its origin. In the meantime the endoderm divides, as already recognized by Häckel and Metschnikoff, into a central cell-mass with distinctly perceptible nuclei, and a small cellular layer applied to the ectoderm. The latter represents the definitive endoderm, while the former is gradually absorbed. The rudiment of the nectocalyx enlarges considerably; the vascular lamella, with its lateral diverticulum, representing the future fluid-receptacle, makes its appearance distinctly; and the embryo attains the form shown in fig. 6. On the third day (fig. 7) the identity with *Monophyes* is unmistakable. The nectocalyx is cap-shaped, shows distinctly the cavities of the four radial vessels, with the annular canal, in its vascular lamella,

and already begins to perform pumping movements, although it is still covered with delicate vibratile cilia. A large swelling, chiefly composed of the juicy endodermic cells, is appended to it laterally, which passes over continuously into the still-closed stomachal sac. The latter is of an intensely red colour, and displays a central cavity free from juicy cells. At its base protrude the numerous fungus-like buds of the rudimentary tentacle. The juicy cells are now absorbed, the tentacle with its urticating batteries elongates, and finally the mouth of the stomachal sac breaks through; and at the close of the third day the larva acquires a form which exactly agrees with that of the youngest stages of *Monophyes* captured in the open.

The proof being thus furnished that the fecundated ovum of *Eudoxia Eschscholtzii* develops into *Monophyes primordialis*, we have to note the following stages in the course of development of the latter:—

1. The planula.
2. The embryo with the bud-rudiments of the nectocalyx and tentacle.
3. *Monophyes primordialis.*
4. *Muggiaea Kochii.*
5. *Eudoxia Eschscholtzii.*

II. *The Relationships of the* Siphonophora.

By the demonstration that three generations intervene in the course of development of the Monophyidæ, several questions are raised, some of which may serve as a directing clue to a further investigation, while others can even now be answered. In the first place, we have to find out whether (as seems to me very probable) the other species of *Monophyes* also present a third generation. In his 'Oceanic Hydrozoa,' Huxley figures several species of *Diphyes* (pl. i. figs. 3, 4, *D. mitra* and *chamissonis*), in which a second nectocalyx was not observed. These possibly represent Monophyids of the structure of *Muggiaea*. But it is not only for the Monophyidæ, but also for the whole of the Calycophoridæ that, for reasons which I shall indicate hereafter, proof of the occasional occurrence of a third generation may be obtained. A further question, which we can even now answer in an affirmative sense, is whether *Monophyes primordialis*, with its complicated alternation of heteromorphous generations, really represents the simplest Siphonophore, or whether it is not rather to be regarded as a retrograde form. In deciding against the latter conception, I depend not only upon its

simple organization, which is reflected in the simple biological conditions, but also upon its embryonic development. If it were a retrograde Siphonophore, we might expect that, as in the case of the larvæ of the Physophoridæ, larval organs would make their appearance, to be afterwards thrown off or replaced by definitive structures. Just on the contrary, the embryonic development of *Monophyes primordialis* presents a simple course, such as the other Siphonophora no longer display. A few days suffice for the conversion of the fecundated ovum directly into the fully developed animal. Finally, we have in favour of its primitive organization the circumstance that all the Calycophoridæ, in their development, pass through a stage which recapitulates, even in its details, the structure of *Monophyes primordialis.* Monophyes primordialis *is the stem form of the Siphonophora.* So far as we at present know the embryonic development of the Calycophoridæ, it follows a course almost identical with that of *Monophyes primordialis.* Throughout, the bud for a nectocalyx is first of all established on the germ, and then one for the tentacle. A larva is formed which sometimes is delusively like the *Monophyes.* Even external characters, such as the cap-like form, are so exactly reproduced, that one might actually take the figure that Metschnikoff gives of the larva of *Epibulia* (*Galeolaria*) *aurantiaca* (Zeitschr. f. wiss. Zool. Bd. xxiv. Taf. vii. fig. 14) for a representation of our *Monophyes.*

If we now examine more carefully the stage of *Epibulia* just mentioned, we are struck in it by a further complication, which engages our interest. Thus, just as the calyx of the *Muggiæa* is established at the base of the stem of *Monophyes*, there is exactly at the same spot in the larva of *Epibulia* the bud for a second nectocalyx. But is this destined to separate from the first calyx on arriving at maturity (which, judging from the opposite position of the apertures of the nectocalyces, appears not improbable)? or does it represent the foundation of the second Diphyid calyx? In one word, do the Diphyidæ also possess three generations, or do they represent more highly developed Monophyidæ, in which two free generations are contracted into one? Further investigation must furnish information upon this point; nevertheless it is to be regarded as an advantage if we are now able to indicate the time and place at which a third generation might occur.

From the preceding statements it must be sufficiently clear that the Monophyidæ show the nearest relationship to the Calycophoridæ. We may indeed regard them as the lowest of the Calycophoridæ, and should best divide this order into three families:—the Monophyidæ, with a single nectocalyx;

the Diphyidæ with two, and the Polyphyidæ with more than two nectocalyces. The family for which I propose the denomination Polyphyidæ, however, shows several peculiarities, as the most noticeable of which it is to be indicated that the individuals are certainly distributed in clusters upon the stem, but that they do not become free in the form of *Eudoxiæ*. Male and female nectocalyces possess a remarkably small umbrella, and bring the sexual products to full maturity in the large manubrium, without separating from the stem as Medusæ. While in the Monophyidæ and Diphyidæ the cyclical development is distributed over two or three generations, these are here compressed into one.

But how is it to be explained that a direct development prevails among the Polyphyidæ and Physophoridæ, to give place again to an alternation of generations in the most highly organized Siphonophora, namely the Velellidæ? In order to answer this question we must go a little further afield. As I have already indicated, the Calycophoridæ possess a hydrostatic apparatus in the form of the so-called fluid-receptacle with its oil-drop. Now in all other Siphonophora, in place of the specifically light oil, a compressible medium, a gaseous mixture, is secreted at the upper extremity of the stem. In them a new organ, the air-sac [*pneumatophore*], makes its appearance; and this, which is originally of small size, gradually acquires more considerable dimensions, until, in the *Rhizophysæ*, *Physaliæ*, and *Velellæ*, it fundamentally influences not only the physiognomy, but even the whole organization. As regards the development of the air-sac, I can confirm Metschnikoff's statements from his investigations on the embryos of *Halistemma pictum* (=*H. tergestinum*, Claus). At the pole of the planula, which advances foremost in locomotion, we observe a solid thickening of the ectoderm, which is finally constricted off from its origin, and, surrounded by the small-celled endoderm, passes somewhat inwards. By the separation of the constricted ectodermal cells a cavity is produced, which is filled with granular fluid and rapidly dilates. The ectodermal cells, with the exception of the portion turned towards the hinder pole of the planula, secrete a delicate chitinous lamella towards the inner cavity of the vesicle, and at the same time begin to secrete a gaseous mixture, which accumulates above the fluid. The perfectly closed air-sac early acquires a flask-like shape, and in the true Physophoridæ never communicates with the outer world. In its relatively inconsiderable development it plays only a subordinate part, so far as locomotion, *i. e.* a rising and sinking, is concerned. On the other hand, this is very effectively per-

formed, as also in the Polyphyidæ, by a great number of nectocalyces, or in the only Physophorid in which the latter are wanting, namely *Athorybia*, by medusa-like natatory movements of bracts.

Are we to regard it as surprising that here, where provision is made for the distribution of the species by means of numerous energetically acting nectocalyces, the sexual animals themselves remain immovably attached to the stem? That in the case of the Monophyidæ and Diphyidæ, with their comparatively insignificant locomotion by means of one or two nectocalyces, the acquisition of mobility by the sexual animals furnishes an efficacious instrument for the distribution of the species can be seen at once. In the Polyphyidæ the male and female individuals still exhibit a medusiform development, but the umbrella appears reduced; while in the Physophoridæ, which are still furnished with numerous nectocalyces, it represents merely a mantle-like envelope of the single ovum.

If, then, our notion is correct, that the separation of the sexual individuals occurs as a compensation for an insufficient power of locomotion and the resulting imperfect distribution of the species, we have, in conclusion, still to inquire how the other Siphonophora, which usually quite give up any active locomotion, effect their diffusion. The Rhizophysidæ and *Physaliæ* have been frequently united with the Physophoridæ. Nevertheless they differ so much from the latter that I prefer placing them as a distinct order, "Pneumatophoridæ," side by side with the Calycophoridæ and Physophoridæ. Their air-sac especially acquires an imposing magnitude, and communicates with the exterior by an opening. Locomotive organs in the form of nectocalyces, or movable bracts, are wanting; and the characteristic "hepatic bands" of the polyps are broken up into numerous isolated villi. While *Rhizophysa* is enabled to ascend and descend by compression of the air-sac, the adult *Physalia*, with its enormous bladder occupying nearly the whole stem, is driven about at the surface of the sea as the sport of the winds and waves.

As to their sexual relations, there still prevails a certain obscurity; and although I may be unable to dispel this completely, I believe I have advanced a step nearer to its solution. Huxley, as is well known, put forward the supposition that in *Physalia* the medusiform buds, seated beside the numerous male medusoid gemmæ, might become developed into female sexual animals and separate from the colony. I doubted long as to the correctness of this hypothesis of Huxley's; but, after the examination of perfectly mature sexual

clusters, for which I am indebted to my friend Von Petersen, I must now thoroughly agree with him. These sexual clusters are from a large *Physalia* which appeared in the Bay of Naples after the spring storms of 1879. At the first glance we detect in them a considerable number of medusæ, which attract attention by their size. By means of long peduncles traversed by a canal they are attached among the gemmæ filled with nearly mature spermatozoa and the sexual tentacles characteristic of *Physalia*. On closer examination a considerable aperture, fringed with a velum, may be easily recognized in the gelatinous umbrella, into the cavity of which it leads. The cavity is lined with ectodermal cells, which in young examples are arranged in projecting pads, in older ones are evenly diffused, and at their base differentiate numerous smooth muscular fibres running circularly. The vascular lamella surrounds the epithelial musculature of the subumbrella, and shows in transverse section the lumina of four vessels, which open within the velum into an annular canal. An ectodermal fibrous cord, which runs at the base of the velum, I am inclined to interpret as a nervous ring. On the other hand, we cannot perceive either tentacular pads, marginal bodies, or sexual organs. A stomachal peduncle, in the wall of which the sexual organs will probably originate, is indicated by a small elevation at the bottom of the cavity of the umbrella.

Now, if we take into consideration the considerable size of these medusæ (they measure 2 millim. in breadth, and 5 to 6 millim. in length with the peduncle), and their organization, which is indicative of a free independent life, there can hardly be any doubt that, after the development of a mouth-aperture and of the tentacular pads, they separate and grow up into female anthomedusæ. Thus, again, in the *Physaliæ*, which are destined to a passive mode of locomotion, the distribution of the species is secured by the acquisition of mobility by the female sexual animals. That the medusæ are really separated appears from the following observation:—In examining the sexual clusters we find now and then gelatinous stalks 3 millim. long, traversed by a vessel. They perfectly resemble the basal pedunculiform section of the medusa-buds, and are easily distinguished from the sexual tentacles. As a matter of fact, a careful examination shows that the medusæ do not separate in their whole length, but that their inferior pedunculiform half remains adherent to the genital cluster. If we consider that the *Physaliæ* always live together in crowds, and that from the enormous production of spermatozoa the contact of these with the ova produced by the

medusæ is rendered easy, it need not surprise us if only the female individuals lead a free existence.

But what I have here communicated with regard to the sexual relations of *Physaliæ*, may with the greatest probability also be applied to those of *Rhizophysa filiformis*. Hitherto certain small clusters of mulberry-like aspect, originating isolatedly upon the stem, were described as the sexual organs of the latter, although no sexual products had been detected in them. I was therefore greatly interested when I was able, in a specimen of *Rhizophysa* which made its appearance in October, to demonstrate that these mulberry-like appendages become developed into sexual clusters, which might almost be confounded with those of a young *Physalia*. Each of the knob-like pads in the cluster begins to draw out into an elongate oval form, appears diminished like a peduncle at its base, and shows in about its middle the rudiment of a medusa-bud. As is shown by still older sexual clusters, there are produced at the periphery of the bud, which still more distinctly shows the form of a medusa, about six or eight excrescences formed of ectoderm and endoderm, while the distal extremity of the whole lateral branch is produced into a sexual tentacle. The oldest genital clusters (those seated at the lower end of the stem) consequently consist of a peduncle abundantly furnished with muscular fibres and very contractile, the cavity of which communicates with that of the stem, and on the other side extends into about twelve lateral branches. Each of these lateral branches, with its appendages, so completely resembles the corresponding parts of *Physalia*, that I do not hesitate to regard the medusa-bud as the producer of the ovum, and the knob-like buds as young seminal capsules. The observation of still further advanced genital organs will show whether, as seems to me very probable, the female individuals also become free in the form of medusæ in *Rhyzophysa*.

At any rate, I believe I have proved that *Rhizophysa* and *Physalia* show a close relationship, which justifies us in raising them into the order Pneumatophoridæ. But what appears to be of special interest in connexion with the question of the origin of alternation of generations among the Siphonophora, is the circumstance that with the cessation of active locomotion (for the ascent and descent of the *Rhizophysa* can hardly come under consideration for the distribution of the species in a horizontal direction) the necessity again occurs of rendering at least the female sexual organs motile in the form of anthomedusæ. If, finally, we glance at the highest Siphonophora, namely the Velellidæ, they appear so perfectly adapted to a

passive locomotion at the surface of the sea, that they cannot compress their chambered air-sac. It is conceivable that, the exertion of any active locomotion being impossible, both male and female sexual animals are set free in the form of small medusæ, namely *Chrysomitræ.*

To summarize briefly, in conclusion, our judgment as to the cyclical process of development of the Siphonophora, I do not hesitate to assert that it shows a close relation to the locomotion. Where numerous energetically acting nectocalyces occur, as among the Polyphyidæ (*Hippopodius*) and Physophoridæ, the sexual animals remain sessile and often degenerate into medusoid gemmæ. Where only one (Monophyidæ) or two nectocalyces (Diphyidæ) produce a comparatively feeble locomotion, the diffusion of the species is provided for by the remarkable process of *Eudoxia*-formation. Nay, it may happen, as I have shown in the case of *Monophyes primordialis*, that the first nectocalyx is replaced by a second heteromorphous one, which is better fitted to carry along the long trailing stem with the *Eudoxia*-clusters. From the primitive organization of this *Monophyes* the life-history of the species therefore appears to be spread over three generations, proceeding one from the other. Lastly, if, as in the most highly organized Siphonophora the Pneumatophoridæ and Discoideæ, the locomotive organs are wanting and locomotion takes place only passively, the diffusion of the species is rendered possible by the sexual animals being rendered motile. There is an alternation of generations that intervenes, as an element of polymorphism, in the course of development of the Siphonophora, and indeed of their highest representatives, in this fashion, that on a polymorphic nurse generation anthomedusæ are produced by gemmation, either females alone (Pneumatophoridæ), or males and females (Discoideæ), which only attain sexual maturity after their separation.

EXPLANATION OF PLATE V.

General Indications:—*g.sch.*, genital nectocalyx; *v*, velum; *s*, fluid-receptacle; *m*, stomachal sac; *f*, tentacle; *st*, stem; *d*, bract; *ek*, ectoderm; *en*, endoderm.

Cyclical development of Monophyes primordialis.

Fig. 1. First generation: *Monophyes primordialis*, Chun, × 45. *x*, bud of the *Muggiæa*-calyx; *fl*, wing-like gelatinous ridges.

Fig. 2. Second generation: *Muggiæa Kochii*, Will & Busch, × 45. K, edges of the calyx. On the last group of individuals the rudiment of the reserve genital calyx is already visible (*x*).

Fig. 3. Third generation: *Eudoxia Eschscholtzii*, Busch, ♀, × 45. The large genital nectocalyx (*g.sch.* 1) had evacuated the ova from

the genital manubrium on the previous day. The second genital nectocalyx (*g.sch.* 2) has become developed within eighteen hours from a simple bud into a nectocalyx already containing the egg-germs; and near it appears the bud-rudiment of the third genital nectocalyx (*g.sch.* 3).

Fig. 4. *Monophyes primordialis* in connexion with the *Muggiæa*-calyx, × 45.

Fig. 5. The young *Muggiæa*-bud, with the first foundation of a cluster of individuals and the uppermost part of the stem, × 210. *g*, lateral vessel; g_2, median vessel; *s.u*, subumbrella; *r.k*, annular canal; *y*, ruptured place of attachment to *Monophyes primordialis*.

Fig. 6. Embryo bud from ova of *Eudoxia Eschscholtzii* on the second day, with the rudiments of the nectocalyx, of the nettling-thread, and of the stomachal sac, × 135. *ga*, jelly; *s.u*, subumbrella; *s.z*, endodermic fluid-cell; *en*, definitive endoderm.

Fig. 7. Larva of the third day, which has already attained the form of *Monophyes primordialis*, × 67. *s.z*, adherent group of fluid-cells.

XXI.—*On Rhynchota from Mergui.* By W. L. Distant.

The small collection of Rhynchota to which this short paper refers was recently made by Dr. Anderson in Mergui, and was placed in my hands for identification by Mr. Wood-Mason. Of course it is quite insufficient to give any estimate of the affinities which this most interesting fauna will ultimately exhibit when adequately worked, but is interesting as affording the first knowledge of the Rhynchota of this little-worked and entomologically little-known zoological district.

Hemiptera-Heteroptera.

Fam. Pentatomidæ.

Catacanthus incarnatus, Drury.

Cimex incarnatus, Drury, Ill. ii. p. 67, pl. xxxvi. f. 5 (1773).

Fam. Coreidæ.

Anoplocnemis grossipes, Fabr.

Lygæus grossipes, Fabr. Syst. Rhyng. p. 205. n. 11 (1803).

Homœocerus tinctus, n. sp.

Ochraceous, thickly covered with fine dark punctures. Antennæ pale castaneous; first joint robust, shorter than second, which is longest, third and fourth subequal in length, second and third slightly infuscated near their apices, fourth, excluding basal third and apex, subinfuscated. Membrane pale smoky hyaline, with the internal basal area black. Rostrum pale ochraceous, with the third and fourth joints subequal, its apex about reaching the intermediate coxæ. Abdomen above pale reddish. Body beneath and legs pale ochraceous. Pronotal angles subprominent and obtusely angulated.

Long. 14–16 millim.

This species is allied to *H. albiventris*, Dall., from which it differs by its much more robust form, different colour of the abdomen above, the basal area of the membrane more infuscated, &c. One specimen alone contained in this collection; I possess a second from Tenasserim.

Fam. **Reduviidæ.**

Ectrychotes atripennis, Stål, var.?

This variety agrees with Stål's description, save in wanting the black spots "maculis tribus magnis lateribus pectoris," but differing also in having the apices of the tibiæ black.

As Stål's species (which I do not possess) was received from Malacca, I have thought that this may possibly be but a varietal form, and have therefore refrained from describing it as a distinct species.

HEMIPTERA-HOMOPTERA.

Fam. **Cicadidæ.**

Cosmopsaltria Andersoni, n. sp.

♂. Head olivaceous. Lateral margins of front, area of ocelli, and a small spot on each side of same black. Pro- and mesonotum olivaceous, the first with a central longitudinal ochraceous fascia, bordered with black, widest anteriorly, and compressed about centre, and with a small curved black line behind the eyes; mesonotum with two obconical spots bordered with black on anterior margin, on each side of which is a small discal black streak and a long curved black spot on each side of base near anterior angles of cruciform elevation, which are also black. Abdomen dull, dark ochraceous.

Underside of body pale ochraceous; annulation to anterior femora near their apices, upper surfaces and apices of anterior tibiæ, bases and apices of intermediate and posterior tibiæ, tarsi, apex of rostrum, and apical portion of last abdominal segment black. Tegmina and wings pale hyaline, the first with the costal membrane and basal portion of venation ochraceous, remaining portion of venation more or less shaded and marked with black or olivaceous and with a black claval streak; wings with the veins black or ochraceous, and outer claval margin and an inner claval streak fuscous.

The body is broad and somewhat depressed, the abdomen above moderately pilose. The head, including outer margins of eyes, is subequal in width or a very little narrower than base of pronotum. The rostrum about reaches the centre of first abdominal segment. The opercula are long, strongly compressed and concave near base, and then widened and convex on each side, but narrowing at their apices, which reach the base of the last abdominal segment. The face is swollen and tumid, with a narrow central longitudinal sulcation and strong transverse striations, the interstices of which are very broad.

Long. 32 millim., exp. tegm. 88 millim.

This species is allied to *C. oopaga*, Dist., from which its smaller size and greater length of opercula at once distinguish it.

Fam. **Jassidæ.**

Tettigonia ferruginea, Fabr.

Cicada ferruginea, Fabr. Syst. Rhyng. p. 60. n. 36 (1803).

Fam. **Fulgoridæ.**

Phromnia marginella.

Fulgora marginella, Oliv. Enc. Méth. vi. pp. 566, 575. n. 43 (1791).

Phromnia rubicunda, n. sp.

Tegmina dull reddish, becoming slightly paler towards apex; the basal, marginal, and apical areas above somewhat irregularly tinged and spotted with chalky white; beneath more evenly and palely tinged with the same colour. Wings white. Body pale ochraceous, the pronotum somewhat darker in hue. Legs pale ochraceous, anterior and intermediate tibiæ and tarsi black, posterior tarsi with the apical joint black.

Tibiæ strongly sulcated, posterior tibiæ armed with three prominent spines.

Exp. tegm. 62 millim.

This species is allied to *P. tricolor*, White, from which it differs by the longer tegmina and different colour of the same, different colour of the tibiæ, &c.

Cerynia maria.

Pœciloptera maria, White, Ann. & Mag. Nat. Hist. xviii. p. 25, pl. i. f. 3 (1846).

XXII.—*On some African Species of the Homopterous Genus* Platypleura. By W. L. DISTANT.

[Plate II. figs. C & D.]

IN his excellent revision of the Cicadidæ (Hem. Afr. iv.), by which the late Dr. Stål for the first time placed the genera of this interesting family of Homoptera on a scientific basis, and cleared up much of the synonymy relating to the African species, he not unnaturally made some errors. Evidently trusting to the notes made when he visited the British Museum and with so much success rectified a considerable portion of the Rhynchotal work of the late Mr. F. Walker, he subsequently (Hem. Afr. iv. p. 19) stated that the *Tettigonia strumosa*, Fabr.,=the *Oxypleura contracta*, Walk., and belonged to the genus *Platypleura*. Mr. Butler, in a list of the species of the genus (Cist. Ent. i. p. 183), in which he uses Stål's revisions, likewise follows him in this course. I have lately, through the kindness of Dr. Aurivillius, been allowed to inspect a typical specimen of the Fabrician species, and find it to be quite distinct from the *P. contracta*, Walk., and that it is the species which I, relying on Stål's identification, had described as *P. ærea.*

The following appears to be the correct synonymy:—

Platypleura strumosa. (Pl. II. fig. C.)

Tettigonia strumosa, Fabr. Syst. Rhyng. p. 34. n. 7 (1830).
Cicada strumosa, Walk. List Hom. i. p. 120. n. 51 (1851).
Platypleura Afzelii, Stål, Öfv. Vet.-Ak. Förh. 1854, p. 241.
Platypleura strumosa, Stål (part.), Hem. Afr. iv. p. 19. n. 12 (1866); Butl. (part.), Cist. Ent. i. p. 191. n. 33 (1874).
Platypleura ærea, Dist. Trans. Ent. Soc. 1881, p. 632.

It is singular that all the specimens which I have been able to examine are females, and consequently it is impossible at present to describe the male opercula and tympana.

The species appears to be distributed in western tropical Africa from Sierra Leone to Calabar.

I now add the description of an undescribed but closely allied species.

Platypleura Rutherfordi, n. sp. (Pl. II. fig. D.)

Head ochraceous; front with a central subtriangular black spot; vertex with a ¬ black mark before the eyes; area of the ocelli and a central basal spot also black. Pronotum greenish ochraceous, with the following black markings:—a central discal black line, dilated on each side anteriorly, not reaching much beyond centre posteriorly, from which two oblique straight lines extend to behind the eyes; and from near the centre of these a longitudinal black streak is emitted; a curved and somewhat dentate line behind the eyes; a central linear spot; and the lateral dilated margins are also black. Mesonotum with two small obconical black spots on anterior margin, on each side of which is a much larger subobconical spot of the same colour, and a central longitudinal fascia and two small basal spots also black; basal cruciform elevation pale ochraceous. Abdomen greenish ochraceous, with the basal segmental margins black. Body beneath greenish ochraceous, somewhat spotted with black; dilated pronotal margins and anterior and intermediate tarsi black. Tegmina pale hyaline; costal membrane and basal fourth dull ochraceous and opaque; the last with the extreme base, an oblique broad terminal fascia, and claval area pale fuscous; a spot at the extremity of the radial area anastomoses with some small adjacent spots near extremities of second and third ulnar areas, and a double submarginal series of small spots placed on the apices of the veins fuscous. Wings pale hyaline, with the basal third obliquely fuscous and a small spot at extremity of radial area fuscous.

The head, including outer margin of eyes, is about equal in width to the anterior margin of the mesonotum; the lateral margins of the pronotum are amply and subacutely produced; the rostrum (the apex of which is fuscous) extends to the first abdominal segment; the opercula are short, broad, and rounded.

Long. ♂, 24 millim., exp. tegm. 76 millim.

Hab. West Africa, Calabar (*D. G. Rutherford*); Isubu.

XXIII.—*Description of a new Species of Rhopalocera.* By W. L. Distant.

Cyrestis Earli, n. sp.

♂. Wings above creamy white, with the basal third of both wings slightly and palely infuscated, with two narrow oblique brownish fasciæ:—the first commencing on median nervure and at about centre of cell of anterior wing, and extending to about centre of submedian nervure, down which it is continued to near anal angle; the second commencing on anterior wing at base of second median nervule, and extending to near apex of the third median nervule of posterior wings, whence it is strongly sinuated and angulated to submedian nervure. Cell of anterior wings with four transverse brownish fasciæ, the fourth at end of cell having a central brownish line; a similarly formed fascia closing cell of posterior wings; an irregular brownish patch beyond cell of anterior wings; at about one third from apex a narrow brownish fascia crosses both wings. The apex of anterior wings is broadly infuscated; and a submarginal series of obscure spots (absent at centre of anterior wings) outwardly margined by a narrow brown fascia crosses both wings; a marginal blackish line; the extreme margin brownish, with creamy white fringe; an ochraceous patch at anal angle of posterior wings, on which are two bluish spots marked with black; caudate appendages bluish. Wings beneath much paler than above; markings generally similar, but spots darker, with a large black spot at anal angle of posterior wings, and the spots between the subcostal nervules of posterior wings and between the second and third median nervules of anterior wings very prominent and black.

Exp. wings 58 millim.

Hab. Malacca. Coll. Godman and Salvin.

This species appears to be intermediate between *C. sericeus*, Butl., and *C. paulinus*, Feld. It will be figured in my 'Rhopalocera Malayana.'

XXIV.—*Description of a new Genus of Geckos.* By G. A. Boulenger.

Microscalabotes, g. n.

Digits of very unequal size, free, slender at the base, strongly dilated at the end, with free distal clawed phalanges;

inner digit rudimentary, not dilated, with strong, very distinct claw; the digital dilatations bearing inferiorly two series of regular oblique lamellæ, separated by a median groove. Upper surfaces covered with juxtaposed granular scales; lower surfaces with imbricate scales. Pupil round. Eyelid distinct all round. Males with præanal pores.

Microscalabotes Cowanii, sp. n.

Head small, much longer than broad, not distinct from neck; snout obtuse, as long as the distance between the eye and the ear-opening, not quite once and a half the diameter of the orbit; ear-opening very small, roundish. Body rather elongate, moderately depressed, not distinct from the tail, which is almost as thick at the base; the latter tapers into a point and is slightly depressed, suboval in section. Limbs rather feeble; digits gradually increasing in size from first to fourth; fifth half the length of the latter; seven transverse lamellæ under the dilated part of the third and fourth digits, the two basal undivided; the slender part of the digits with narrow transverse lamellæ. Upper surfaces covered with uniform small granular scales, considerably larger on the snout and interorbital space. Rostral broad, subpentagonal; nostril pierced between the rostral, the first upper labial, and two nasals, the upper nasal being the largest and separated from its fellow on the other side by two granules; six or seven upper and as many lower labials; mental rather large, subtriangular; irregular small chin-shields, gradually passing into the gular scales. Latter relatively large, though considerably smaller than the ventrals, which are large, smooth, and distinctly imbricate. Six or eight præanal pores forming a short angular series. Caudal scales uniform, cycloid, imbricate, largest on the lower surface. Reddish-golden brown above, with darker greyish-brown vertebral and lateral bands; tail with more or less distinct darker angular markings; labials brown-dotted; lower surfaces whitish, the throat with a few scattered brown dots.

	millim.
Total length	73
Head	9
Width of head	6
Body	22
Fore limb	10
Hind limb	13
Tail	42

Two male specimens were collected in East Betsileo, Madagascar, by the Rev. W. Deans Cowan.

This new genus is related to *Phelsuma*, Gray, and *Lygodactylus*, Gray (=*Scalabotes*, Peters), both of which occur also in Madagascar, and have likewise the very unequal-sized digits with rudimentary thumbs, the completely exposed circular eyelid, the circular pupil, &c. From the former it is easily distinguished by the presence of claws and the divided infradigital lamellæ; from the latter, to which it stands nearer, it is distinguished by the distal clawed phalanges, which are free, as in *Lepidodactylus*, Fitz., and not curved and retractile between the anterior infradigital lamellæ; the claw of the inner digit is very strong and always exposed, and not sheathed and frequently hidden as in *Lygodactylus*.

XXV.—*Some Remarks on the Vaagmær* (Trachypterus arcticus) *and the Herring-king* (Regalecus Banksii). *By* Dr. C. Lütken*.

I have elsewhere† published in full detail the investigations that I have had the opportunity of making upon the two northern Bandfishes mentioned in the title; and that I desire here to give a brief report upon the results at which I think I have arrived is due to my wish to preserve a certain historical continuity. They have both been the subjects of descriptions and investigations in the memoirs of our Society in former years:—the Vaagmær, by M. T. Brünnich in the third volume (1788), and by the older Reinhardt in the seventh volume (1838); the King of the Herrings, by Ascanius and Brünnich in the first-mentioned volume and year. Of the smaller and less fragile of these two remarkable deep-sea fishes, the Vaagmær, there had accumulated in course of time, and especially of late years, in our Museum, partly, no doubt, in consequence of the greater development of collecting-voyages, a material of no less than thirteen Danish, Icelandic, and Færöic individuals, varying in size from 0·830 to 2·200 metres. This material demanded a comparative investigation before it should be in part divided and dispersed among foreign collections, so far as we could spare it from our own. The materials of the second, larger, scarcer, and more fragile

* Translated by W. S. Dallas, F.L.S., from the 'Oversigt over det Kongelige Danske Videnskabernes Selskabs Forhandlinger 1882, pp. 206–216.

† 'Videnskabelige Meddelelser fra den naturhistoriske Forening for 1881,' p. 190, with figures.

northern Bandfish were much more limited and defective; but they have nevertheless sufficed to answer, at least provisionally, more than one question relating to it; for with regard to both these comparative rarities in our museums there were, and indeed still are, many such remaining to be settled.

Thus, with regard to the Vaagmær, it still required to be settled whether our northern Vaagmær (or our northern Vaagmærs, in case there should be more than one species) is or is not distinct from the forms observed elsewhere, especially in the Mediterranean or in the neighbouring part of the Atlantic. The question has certainly always been answered in the negative, but yet could not be regarded as perfectly settled so long as comparisons had been instituted only upon scanty materials and not between individuals of tolerably corresponding age and size; and that a pelagic form like the Vaagmær was not confined to the northern seas alone (where it is known from Iceland and the northernmost part of Norway to the Færöes, Skagen, Norfolk, and Donegal, but not from the western, American side of the northern sea), seemed in itself not to be improbable. The question has lately been much simplified by the investigations which have been made upon the changes of form with age, or the developmental history, of the Mediterranean forms. Moreover our museum possesses some materials towards the recognition of the connexion between the age-forms formerly established and described as distinct species and under different specific names; but I was freed from the necessity of devoting to them a discussion, which must have been very incomplete, in my 'Spolia Atlantica,' by the appearance, in 1880, of Ennery's "Contribuzioni all' Ittiologia" (Atti d. R. Accad. dei Lincei), founded upon much more copious materials. Referring here to this, or to the exposition which I have given (*loc. cit.*), from this source and from my own materials, of the history of the transformations of the Mediterranean species (*Trachypterus iris*, Wb.), I confine myself to indicating that the reduction of the species can hardly be restricted to declaring *T. filicauda* (16–32 millim.), *Spinolæ* (2¼–3¾ inches), *iris* and *tænia* (up to 2 feet) to form only a single species; we may unite with them without hesitation *T. liopterus*, C. & V. (about 4 feet), and *T. Rüppeli*, Günth. (about the same size), and perhaps also *T. gryphurus*, Lowe; and it may in general be a question whether we know more than this one species from the Mediterranean and the neighbouring part of the Atlantic. That this is specifically distinct from *T. arcticus*, Bn., there can be no doubt, although it is difficult to indicate any but purely

physiognomical differential characters, namely the more elevated form of the body in *T. arcticus*, together with its shorter and more suddenly contracted tail, in contradistinction to the more elongated and more gradually narrowed tail in the fully developed *T. iris*. Besides the northern seas, *Trachypteri* are known from Chili and from the Indian Ocean; but as to their relations with the northern and Mediterranean species I can say nothing positive; it is probable, however, that they are distinct from the latter, and that the *Trachypteri* in general do not belong to the genera of deep-sea fishes the species of which have, so to speak, a cosmopolitan distribution.

As it has been attempted to distinguish two northern species (*T. arcticus* and *T. vogmarus*), it is not superfluous to remark that the existing material certainly furnishes no support to any such separation, which must be absolutely rejected; and so far as this is founded upon the supposed observation that certain Vaagmærs are apparently askew or asymmetrically formed, which has been stated in connexion with the mode in which they have been seen to move through the water, it must be remarked that I have found it impossible to convince myself of the existence of this asymmetry in any of the specimens investigated. So far as I can make out, it does not exist at all, or, in any case, it is very inconsiderable.

Of the other external characters of the northern Vaagmær there were especially two which needed confirmation by the comparison of a large series of specimens, namely:—1, the absence or the presence in the more or less adult Vaagmær of *nuchal fins*, or of the anterior part of the dorsal fin, always apparently composed of five rays, of which part a rudiment is certainly always present, but which has never been seen in its full development in any northern Vaagmær, as in general no young stages of these corresponding to *T. filicauda* or *T. Spinolæ* are yet known; and, 2, the absence or presence, as a normal character, of the *ventral fins*, of which also we can in general detect more or less distinct traces, but which have not hitherto been found fully developed in any northern Vaagmær.

The answer to these questions is as follows:—In all the twelve individuals from 0·935 to 2·200 metres in length, the rays of the nuchal fin were broken off at the root, even though the rest of the dorsal fin was in general perfectly well preserved; they were in part so concealed within the skin that it was often difficult to count them; and to all appearance they had been lost very early, while the fish was still quite young; they were, however, more distinct (8 millim.) in the thirteenth, still smaller specimen (0·830 metre long), the youngest of the whole series. In this also distinct rudiments

of the ventral fins were present—namely, on each side an anterior (or outer) ray, about 7 millim. long, but broken, and therefore, in reality, longer, comparatively slender, strongly spinous along its anterior margin, and behind this five shorter and finer ray-rudiments. In all the other Vaagmærs examined these rudiments of ventral fins were very indistinct or had even completely disappeared, except in one (1·505 metre), in which there were two basal portions of the anterior rays of the ventral fins, about 20 millim. long and 3 millim. broad, subprismatic, flat behind, with a rounded angle in front; and it was clear that they had been 30 or perhaps 50 millim. long. Exceptionally, at any rate, this first ray in each ventral fin may therefore exist in the fully developed state, as in *Regalecus* (*Gymnetrus*), in adult Vaagmærs; and we cannot absolutely place the absence of this fin in the adult Vaagmær as a character of this genus in contradistinction to its allies. From what I have seen in young Mediterranean *Trachypteri*, I have been led to think that the loss or casting of the nuchal and ventral fins was rather a shedding prepared by nature than the consequence of an accidental fracture; but I admit that further investigations upon this point are to be desired.

The measurements made of the individuals before me and their comparison have shown (as will appear more clearly from a table of numbers given at p. 204 of my detailed memoir) no small variation in the proportions of the parts of the body and in other analogous characters. I had hoped to be able to show definitely that these variations to a great extent corresponded to differences of age, so that in the height of the body, of the dorsal fin, and of the caudal fin, in the higher or lower position of the lateral line, in the size of the head and eye, in the abruptness of the profile, &c. there would be a diminution or an increase in parallelism with the age and the size of the body. But this hope became fainter and fainter the more specimens I examined. In part, however, the apparent vacillation and irregularity in these characters may be explained by the circumstance that these delicate fishes are contractile, and therefore may change their form considerably, according as they are hardened by placing them in salt or in alcohol, or preserved in a more flaccid condition. To get over the difficulties which are thus produced is, so to speak, impossible; and I must therefore confine myself to indicating within what limits I have found these characters variable, and how far they may be considered to stand in any connexion with differences of age.

The length of the head and body **together (as far as the anus), in proportion to the total length, varies between 1 : 1·76**

and 1 : 2·04; but it is quite exceptionally that the tail (from the anus) is a little longer than head and body together, so that the anus comes to be situated before the middle of the total length instead of, as always elsewhere, behind it.

The length of the head (from the apex of the closed mouth to the posterior margin of the operculum) is contained from about seven to about nine times in the total length; it seems to be relatively small in the larger specimens and great in young examples.

The greatest height of the body is contained about four and a half to six and a half times in the total length. That the height decreases proportionally with the age, at least to a certain point, to increase again in older individuals, although it may seem probable, does not appear from the measurements.

The size of the eye (diameter of the orbit) is contained from three to four times in the length of the head, and seems, as indeed is generally the case, to undergo a relative diminution with age.

The rays of the dorsal fin vary in number from 154 to 186 (besides the rudimentary nuchal fin-rays). In very young individuals (0·830 metre) they are rather rough to the touch in their lower part; in older specimens this roughness has disappeared, except the spine at the base. Their average elevation (determined by the length of a ray directly over the anus) is, in proportion to the greatest elevation of the body, between 1 : 1·7 and 1 : 3·3, and may therefore vary between more than one half and scarcely one third of that measurement; it is on the average relatively higher in the young and lower in the older fishes. The number of *pectoral fin-rays* may be from ten to thirteen.

The caudal fin-rays are in general eight, and only exceptionally seven in number; they may be rough, especially in young individuals, and chiefly the first and last. The height of the caudal fin (*i. e.* the greatest length of its rays) is, in proportion to the total length, as 1 : 5·5 to 1 : 10·7; it may therefore be relatively twice as great in some as in others, independently of the injuries to which it is exposed at all ages: it seems on the whole to be relatively highest in young and lowest in old specimens. Perhaps also the root or peduncle of the tail is, as a rule, relatively shorter in the younger specimens; but its limit towards the wider part of the caudal fin is often impossible to determine, when the two pass gradually into one another. The caudal fin can in general lie directly backward; and this position is perhaps quite as natural as the nearly vertical position. In the rudiment of the *anal fin* the normal number of rays is certainly five,

besides the spine situated immediately in front of it: I have also noted the finding of six or seven; but in this case it is easy to make a mistake.

The position of the lateral line may be a little lower or higher. The proportion between its distance from the anus and the height of the body at the same part is from 1 : 2·17 to 1 : 2·80; as a rule it is relatively lowest in the higher individuals. It contains about 102–110 scales, the little spine of which, especially in the younger individuals, may be distinct to the origin of the lateral line; in the last 9–14 it is, as is well known, large and sharp.

The facial profile may be more or less abrupt; but the physiognomical difference thereby produced is perhaps dependent rather upon accidental circumstances than upon age. The number of *teeth in the jaws* may vary from $\frac{1-1}{2-7}$ (higher numbers have been observed by others): the *vomerine teeth* are 1–5 in number; but it would appear that they may be completely absent: of *upper pharyngeal teeth* there are 4, 4, and 5 on each side, on the three pairs of upper pharyngeal bones. An *opercular branchia* is present; and the adoral excrescences of the *branchial arches* bear some small teeth at their apex; there are 12–13 such excrescences on the anterior, and 10–7 on the posterior branchial arches, not reckoning the fifth gill-less arch (the existence of which has been erroneously denied), which has only 6–7.

The three black spots on the side of the body are especially distinct upon very young individuals; in older ones we often see only one or two lateral spots; and they are generally less distinct or entirely absent in fishes which have been long preserved.

The comminuted seaweeds (*Zosteræ* and Florideæ) with which the stomach is often found to be much distended, are of course not the natural food of the Vaagmærs, but merely taken for want of better in the neighbourhood of the coasts on which they get stranded.

Of the second, larger, rarer, and also more fragile northern Bandfish, the so-called King of the Herrings, "Sildekonge" or "Sildetust," *Gymnetrus* or *Regalecus*, a specimen has only once, namely in 1852, been sent to the museum, from the Færöes; and this was by no means in good preservation, wanting the head, with only rudiments of fins, and cut or broken into three pieces. Fortunately the museum afterwards

received a drawing of the animal * made before it had suffered all this damage, and while it was still almost uninjured. As so much uncertainty still prevails with regard to the species of *Regalecus*, and especially the northern species, of which no fewer than three have been established, even this example and the illustrations of it now before us are of importance towards the knowledge of the structure of the genus and the species, and in the discussion of the specific identity or distinctness of the specimens which are stranded from time to time on the Norwegian or English coasts. In all, so far as they have been recorded, there have been about 30 in 140 years, or one every fourth or fifth year. As in my detailed memoir I have discussed this matter from different points of view, I shall refer to it, and confine myself here to a few brief remarks. The specimen from the Færöes was nearly 12½ feet long; its greatest elevation a little before the anus 1 foot; length of the head about ¾ foot; distance from the anterior extremity of the head to the anus hardly 5 feet, or ⅖ of the total length. The posterior or caudal extremity was obliquely truncated and without any fin; the ventral fins were represented by two long nearly glassy rays with a rhombic cross section, the length of which, according to the drawing, was 3¾ feet, or about $\frac{3}{10}$ of the total length. In the true dorsal fin there were 256 rays; but immediately in front of it there were two high and pointed nuchal fins, the total number of rays in which cannot be stated exactly (there seem to be 11, but may be more). While the ventral fin-rays, according to the drawing, were membranously dilated at the end; this is not the case with any of the nuchal fins, although, according to other figures of *Regaleci*, it might be supposed that at least the hindmost nuchal fin-rays were thus completed. Every thing indicates so complete an agreement with the "*Regalecus Banksii*," captured in 1849 on the English coast, which is of all specimens the one that has been most perfectly investigated and described and the best figured, that there can be no doubt of its specific identity with that fish. It is probably of little consequence that there is nothing to indicate that the fish from the Færöes had the oblique black streaks which are seen in the figures in the "Annals and Magazine of Natural History, 1849"—with respect to which it must also be remembered that in them the nuchal fins are restored according to the statements of the fishermen, and therefore not exactly reproduced, any more than the figures in other works founded upon

* A photoxylographic reproduction of this drawing is given in my detailed memoir, p. 209.

that of Hancock and Embleton. There is certainly no reason to doubt that it is upon specimens of the same species that most of the other statements concerning similar fishes on the English coasts, and also of late upon those of Norway, are founded; small variations in the number of dorsal rays (*e. g.* 303, 279) cannot justify such doubts. Doubt first arises with regard to the so-called "*Regalecus Grillii*," Lindroth (Svenska Akad. Skrifter, Bind xix. 1798), which united with a colossal size (18 feet), and a relatively considerable length of the part of the body situated behind the anus, the great number of about 400 dorsal fin-rays—a statement the approximate correctness of which there is the less reason to doubt, because *Regaleci* with a similar number of rays are known in the Mediterranean. We may also doubt with regard to the "*Regalecus glesne*," or "*Gymnetrus remipes*," described at an early period in the memoirs of our Society, which with a smaller size (10½ feet) and a remarkably reduced number of rays (probably about 168) combined a termination of the caudal extremity and dorsal fin such as is otherwise unknown and certainly not very natural, and with respect to which it is impossible to indicate how much is due to the art of the preparer and how much to an original condition which elsewhere disappears by the peculiar mutilation or curtailment which the caudal extremity always seems to suffer to a greater or less extent in these fishes. This curtailment occurred, and essentially in the same manner, in the Færöe example, in Lindroth's, in the English specimen described by Hancock and Embleton, in a specimen taken in 1881 at Stavanger (upon which Mr. Collett has given me the information published at p. 214 of my memoir), as well as in the *Regalecus* stranded in 1868 at the Cape of Good Hope, and described by Layard; and we may therefore regard it as probably a common peculiarity of *Regaleci* of a certain size. A less abnormal termination of the caudal extremity, with a normal caudal fin &c., is probably originally present, as is perhaps indicated by the fish observed by Russell at Vizagapatam, only 2′ 8″ long, and which has not been heard of again for nearly a century; but this apparently will disappear at an earlier or later period by the truncation or casting-off of the extremity of the tail. Perhaps this mutilation is repeated from time to time upon occasion given; or perhaps it originates a regeneration which produces the great number of rays observed in certain large and old individuals, such as Lindroth's specimen, and, connected therewith, a relative elongation of the caudal part of the body. A part of the measurements of different individuals brought together at p. 215 of my memoir will agree very well with the notion that the tail elongates during the growth of the fish, while the

number of rays increases, and the height of the body and the length of the head relatively to the total length diminish; but it can by no means be stated that this always and everywhere holds good. In all probability "*R. Grillii*" is nothing but an unusually large and old *R. Banksii*. With regard to "*R. glesne*" nothing can be said with certainty; but under any circumstances it is a doubtful species. Its small number of fin-rays is also ascribed to the above-mentioned specimen from Stavanger, which is rather smaller (9½ feet); but this had the caudal extremity truncated after the usual fashion of the King of the Herrings.

Beyond the northern seas, *Regaleci* have been observed in the Mediterranean (*R. gladius* and *telum*), off the Bermudas, New Holland, New Zealand, and the Cape; but whether in these cases we have to do with several distinct species it is impossible at the moment to decide. That the genus is tolerably cosmopolite is clear; but whether its species are few or many we cannot yet say.

As regards the characteristic differences between the two genera, which are certainly very nearly related, but which are more than the mere results of an artificial classification resting upon external characters, I may in conclusion indicate as a splanchnological difference that the stomachal cæcum, at least in *Regalecus Banksii*, is continued far beyond the anus, nearly to the extremity of the tail, along the right side of the median partition. There are also some osteological differences. The skeleton of the body is certainly extremely feeble in both genera, but weakest in *Regalecus*. The number of vertebræ is not very different (in the Vaagmær I have counted 97 and 100); the vertebræ are on the whole shorter, stronger, and more compressed in the Vaagmær, and generally more elongated in the King of the Herrings, apart from the differences which prevail in these respects in different parts of the vertebral column. The number of interspinous bones in the *Regalecus* is twice or three times that of the vertebræ; in the Vaagmær of course not twice as great. There also appears to be this difference: the ribs are completely absent in the Vaagmær, while the King of the Herrings has true ribs upon the vertebræ from the eighth to the twenty-fourth, the anterior ones directed obliquely backwards, and the hinder ones gradually acquiring a position more and more approaching the horizontal. From the twenty-fifth vertebra these structures are replaced by fine double hæmapophyses, which at first are short and vertical, and then become longer and attain a more oblique position. For more ample details upon these and other characters of the skeleton I must refer to the third section of my detailed memoir which has been so often mentioned.

XXVI.—*Shells of the Littoral Zone in Jersey.—Supplement**. By E. Duprey.

The littoral zone of the south coast of Jersey is the rich field that has yielded the following additional harvest of shells. The greater number are of small size, and have been obtained by sifting seaweeds about low-water mark and in rock-pools. Many have been found in fine shelly gravel, a few others in a peculiar and, I believe, hitherto unnoticed habitat.

Conchologists are well aware that the ordinary and common abode of a great variety of marine animals is under stones. But if such stones as lie flat upon the ground are often turned over and examined, those which are buried more or less deeply are overlooked. At first sight their appearance is not promising, especially when the upper surface alone is visible; yet I would invite attention to them when in the lower part of the littoral zone.

It may be found hard work to turn over stones buried 8 or 10 inches or more, and weighing upwards of a hundredweight; but a welcome reward will often follow. Surprising as it may seem, *living* under the ponderous mass delicate and rare little mollusks come into view, such as *Argiope capsula*, *Chiton scabridus* and *C. cancellatus*, *Rissoa striatula* and *R. lactea*, *Adeorbis subcarinatus*, and *Arca lactea*, this last rarely. I have also noticed an Ascidian, a *Serpula*, a *Spirorbis*, and a few sponges, one of which forms a thin brown velvety pile. These underground marine mollusks are mostly gregarious; and four or five species may be found living together. It is also worthy of notice that their shells are all devoid of colour, being whitish or stained with a ferruginous tint. Sometimes (as in the case of *Rissoa striatula* and *R. lactea*) the stones are imbedded in a firm clayey sand; but generally the ground consists largely of stones and pebbles, intermixed with sand and gravel and a little mud. Such a soil is easily permeable to water, but not shifting to any extent, as proved by the growth of algæ and *Zostera*. A glance at one of the "good" stones when turned over is enough to show that only a portion of the under surface was in contact with the underlying soil. The other or "fertile" portion must have overlain a space filled with clear water, and formed, as it were, the roof of a miniature underground cavern. The force of the current above during the ebb and flood of the tide is no doubt sufficient to induce a slight flow of the water permeating the loose

* See the Ann. & Mag. Nat. Hist. for October 1876.

soil, thus supplying the wants of the little inhabitants, who, if deprived of light, live concealed, and thus protected, from many of their enemies. I may add that the shells of the Rissoas and Chitons are not worn, as must be the case if they were habitually rubbed against and forced through sand.

Beyond low-water mark, secure in this "buried habitat," these and other perhaps unknown species may long defy the efforts of the dredger.

Most of the species have been found alive; when otherwise, mention is made that dead shells only have been met with.

The nomenclature is that of Dr. Jeffreys's 'British Conchology;' and in this, as well as in my first list of Jersey shells, the more rare or doubtful species have been submitted to the kind inspection of Dr. Jeffreys.

BRACHIOPODA.

Argiope capsula, Jeffr. This minute shell, hitherto obtained only with the dredge, is also an inhabitant of the littoral zone on several parts of the coast of Jersey, where it is found in the "buried habitat" previously described; often in company with *Chiton scabridus*, *Adeorbis subcarinatus*, and other species. Gregarious and abundant, not unfrequently a hundred and more may be seen attached to the same stone. I have even met with it under some which were completely hidden from view beneath the soil. But the advancing tide will seldom permit one to pick them all from the rough surface, as this must be done one by one, for they are easily crushed. A brush does not answer. Full-grown shells are about 0·04 inch in length. The *colour* is white; but very often they have a rusty appearance, from being attached to a piece of ferruginous hornblendic rock.

CONCHIFERA.

Lima subauriculata, Mont. Valves only; they are not uncommon in shelly gravel,

Mytilus modiolus, L. Valves only.

Modiolaria marmorata, Forbes. As usual, in the skin or tegument of an ascidian affixed to the "roots" of a *Laminaria*. Also amongst seaweeds (young specimens).

Crenella rhombea, Berkeley. A few valves in shelly gravel in Pontac and Samarès Bays.

Lepton nitidum, Turt. Valves only.

—— *sulcatulum*, Jeffr. In siftings; rare.

—— *Clarkiæ*, Clark. Found living in St. Aubin's and Samarès Bays. The young shells are transparent and glossy; the adults generally have a rusty appearance. Odd valves are not uncommon.

Montacuta bidentata, Mont. Dead shells in St. Aubin's Bay.

Kellia suborbicularis, Mont. This is a newly recognized inhabitant of the middle portion of the littoral zone, where it was first found by the Rev. F. Lallour in shallow rock-pools, nestling in the nooks and crevices in the thick calcareous crusts of *Melobesia polymorpha*. I have met with it on several parts of the coast in this habitat. This is perhaps a littoral variety; the *incurrent tube* of the animal is fully as long as the shell is wide, whilst the *excurrent tube* is sessile. My largest specimen is ¼ of an inch in breadth.

Axinus flexuosus, Mont. Found living in sand amongst *Zostera* with *Loripes lacteus* and *Lucina borealis* (a small var.). Odd valves are very common in St. Aubin's Bay.

Cyamium minutum, Fabr. In rock-pools amongst small seaweeds; far from common and of a whitish colour.

Cardium tuberculatum, L. Living, in St. Aubin's Bay.

—— *fasciatum*, Mont. A valve only.

Circe minima, Mont. Living at low water in coarse gravel at La Rocque and in Samarès Bay.

Venus gallina, L. In St. Aubin's Bay.

Lucinopsis undata, Penn. In gravelly sand at La Rocque.

Tellina pusilla, Phil. Dead but fresh-looking shells.

Psammobia tellinella, Lam. Besides the ordinary or coloured form, it also occurs of a pure white.

—— *Ferroënsis*, Chemn. Living in St. Aubin's Bay.

Donax politus, Poli. Sometimes of a uniform very light colour (one only).

Scrobicularia prismatica, Mont. Dead shells.

—— *alba*, W. Wood. Living in sand.

Ceratisolen legumen, L. Dead shells only.

Solen pellucidus, Penn. A few specimens with *S. ensis* in St. Aubin's Bay. Both species emerge quite out of the sand as the tide begins to rise.

Thracia papyracea, Poli. This and the next species have been found alive at La Rocque (*Rev. F. Menard*).

Corbula gibba, Olivi.

Saxicava rugosa, L. In default of limestone this boring shell avails itself of the thick calcareous crusts of *Melobesia*, where it is occasionally found in rock-pools not much below half-tide. Young and very small specimens are also found nestling in the crevices of pieces of cork (net-floats).

Teredo navalis, L. In timber from the lower portions of the old landing-stage in Victoria Harbour.

—— *megotara*, Hanley, var. *mionota*. In floating timber, cast ashore.

—— ——, var. *subericola*. This minute form is occasionally found alive or quite fresh in bottle-corks and net-floats left on the shore by the tide.

GASTROPODA.

Chiton scabridus, Jeffr. This newly recognized addition to the list

of British mollusks is not uncommon in the "buried habitat" before mentioned; as many as half a dozen occur sometimes under one stone. *C. cancellatus* is occasionally found with it. Adult specimens are ¼ inch long. For description of animal and shell see the 'Annals & Magazine of Natural History' for July 1880.

Cyclostrema nitens, Phil. Not full-grown; in siftings from Samarès Bay.

Trochus tumidus, Mont. Dead shells are not uncommon in shelly gravel from about low-water mark in the same locality.

—— *cinerarius*, L., var. *pallescens.* Without coloured markings; corresponding with the variety *pallescens* of *T. umbilicatus.*

Rissoa cancellata, Da Costa. Found dead with *Trochus tumidus.*

Although a common Herm shell, I have not found it alive in Jersey, where in its place *R. lactea* is rather common. Of this last I have several times found more than a dozen, and once forty-three alive, under one stone.

—— *calathus*, F. & H. With *R. cancellata*, but more rare; dead shells only.

—— *inconspicua*, Alder, var *variegata.*

—— *fulgida*, Adams. Abundant.

—— ——, var. *pallida.*

—— *semistriata*, Mont., var. *pura.*

Hydrobia ulvæ, Penn. Rather small.

Jeffreysia diaphana, Alder. Obtained by sifting small seaweeds. My largest are hardly 0·06 inch long.

—— *opalina*, Jeffr. With the preceding; my largest are only 0·06 inch in length.

Skenea planorbis, Fabr., var. *maculata.*

—— ——, var. *hyalina.*

These two varieties live amongst small seaweeds, whereas I find the reddish-brown or typical form in fine gravel.

Homalogyra atomus, Phil., var. *vitrea.*

Another variety has on the last whorl three reddish-brown bands on a light-coloured ground.

—— *rota*, F. & H. In siftings from St. Aubin's and Samarès Bays and from Pointe des Pas. Occurs sparingly, and is difficult to find, on account of its extremely small size.

Truncatella truncatula, Drap. Dead shells.

Aclis unica, Mont. In siftings from Pointe des Pas. Rare.

—— *supranitida*, S. Wood. A dead specimen in fine shelly gravel.

Odostomia nivosa, Mont. In rock-pools.

—— *Lukisi*, Jeffr. Dead specimens.

—— *albella*, Lovén. Not uncommon in rock-pools.

—— *rissoides*, Hanley, var. *dubia.* Dead.

—— *plicata*, Mont.

—— *diaphana*, Jeffr. Rare. (Near the Hermitage.)

—— *obliqua*, Alder. Rare. (St. Aubin's.)

—— *Warreni*, Thompson. At St. Aubin's and La Rocque.

—— *decussata*, Mont.

—— *interstincta*, Mont.

Odostomia interstincta, var. *terebellum*.

The seven last species I have found dead only, in fine shelly gravel from low water.

—— *spiralis*, Mont. Alive in a rock-pool in St. Aubin's Bay.

—— *fenestrata*, Forbes. Dead.

—— *pusilla*, Phil. Dead only.

Ianthina rotundata, Leach. About the middle of July 1879, after long-continued westerly winds, Ianthinas were cast ashore about high-water mark. They were only half-grown ; and the animals, although apparently dead, were quite fresh. Nearly one third had their *float* still attached. Many cartilaginous shields of *Velella* were found at the same time.

Eulima intermedia, Cantraine. Dead and broken shells in Samarès Bay.

—— *distorta*, Deshayes.

Velutina lævigata, Penn. A dead specimen.

Cerithiopsis tubercularis, Mont. Amongst seaweeds and under stones. Size very variable.

Murex erinaceus, L., var. *melanostoma*.

Defrancia linearis, Mont. Dead.

Pleurotoma costata, Donovan. Dead.

—— *nebula*, Mont.

Utriculus mammillatus, Phil. Dead.

—— *truncatulus*, Brug.

—— *obtusus*, Mont. The dead shells are common ; the living rather rare.

Bulla striata, Brug. A dead and rather worn specimen in St. Aubin's Bay. Perhaps brought in ballast.

Melampus myosotis, Drap. Dead.

—— ——, var. *ringens*. Dead.

Otina otis, Turton. I have found the empty but fresh-looking shell in siftings from Pointe des Pas.

CEPHALOPODA.

Loligo media, L. Caught with a net near low water in St. Aubin's Bay.

LAND SHELLS.

Limax arborum, Bouch.-Chant.

—— *lævis*, Müll.

Testacella Maugei, Fér. At different times the late Dr. M. Bull found a specimen crawling at the foot of a garden-wall in St. Saviour's Road ; and I have since obtained several from that neighbourhood. When full-grown the shell is half an inch in length.

Helix concinna, Jeffr. Dead.

Achatina acicula, Müll. My specimens have been found in a garden.

Cyclostoma elegans, Müll. Dead and empty, but with the operculum still closing the aperture.

This last, together with *Helix concinna*, *Melampus myosotis* and its variety, and *Truncatella*, I have found on the shore only, mixed with more common land-shells, a few days after a very high spring-tide. They were all full of air, very buoyant, and were left on the sand by the receding tide at its upper limit. May they not have been wafted over from the opposite coast of France by the strong tides and currents?

XXVII.—*Descriptions of four new Species of Helicidæ.* By Edgar A. Smith.

The British Museum has recently purchased a small series of shells, said to have been collected at D'Entrecasteaux Island, off the south-east of New Guinea. Besides the new species about to be described, it includes examples of *Helix Tayloriana*, Adams & Reeve, = *H. yulensis*, Brazier, *Helix Broadbenti*, Brazier, and a very beautiful variety of *H. corniculum*, Hombron & Jacquinot. It is rather larger than Reeve's figure (Conch. Icon. f. 502), and has the black band twice as broad, and the lip much more expanded and of a pretty rose-colour.

Helix (*Geotrochus*) *Tapparonei.*

Testa imperforata, trochiformis, lactea, labrum versus lutescens, superne zonis tribus vel quatuor inæqualibus nubilo-rosaceis (una prope suturam interrupta) ornata, undique minute, oblique corrugata. Anfractus quinque, levissime convexi, celeriter accrescentes, sutura lineari sejuncti; spira concaviuscula, apice elevato, subobtuso, nigro; anfr. tertius et quartus infra suturam lactei, inferne roseo suffusi; ultimus in medio acute angulatus, inferne paulo convexus, prope labrum subito valde descendens; apertura valde obliqua. Peristoma saturate nigrum, contractum, margine dextro insigniter bisinuato, aliquanto infra medium columellam versus acuto producto, vix expanso; margo columellaris latus, reflexus, vix planus sed leviter excavatus, in medio marginis tuberculis duobus parvis munitus, superne callo nigro longe intrante labro junctus.

Longit. 24 millim.; lat. maxima 38, min. 30.

I do not know any species sufficiently approaching that now described with which a comparison can be made. *Helix Macgillivrayi* has a somewhat similar indentation of the outer

lip, but much less pronounced, in other respects being totally distinct. The peristome in *H. Tapparonei* is most remarkable, being so peculiarly contracted that the most prominent part of the whorl is at the carination. It is broadly margined with intense black, with the extremities united by a callosity of the same colour, which extends upon the penultimate whorl within the aperture as far as the eye can reach. The rest of the interior is rosy white. The outer lip at the margin is only a little thickened and reflexed; but at the base the reflexion is somewhat greater, gradually widening as the columella is approached. With the exception of the black peristome, the base of the shell is uniformly cream-colour, which towards the front is rather yellower. The upper surface, however, is ornamented with spiral bands of a lilac-rose tint, in some specimens ill defined or coalescing, so that this colour predominates.

Helix (*Geotrochus*) *latiaxis*.

Testa subsolida, imperforata, depresso trochiformis, in medio mediocriter acute angulata, sublilacea, apicem versus livido-nigrescens, epidermide caduca, fusca, zonis concentricis disposita ornata, undique minute concentrice granulata, lineisque incrementi obliquis sculpta; spira mediocriter elevata, marginibus vix convexis, apice subobtuso. Anfractus quinque, convexiusculi, celeriter accrescentes, sutura lineari discreti; anfr. ultimus inferne paulo convexus, antice maxime oblique descendens, pone labrum leviter constrictus, zonis sex, tribus supra, tribusque infra angulum ornatus. Apertura valde obliqua, intus cæruleo-alba; peristoma saturate nigrum, undique late expansum, marginibus callo crassiusculo nigro junctis; columella latissima, complanata vel concava, margine aperturam versus subrosaceo, in medio parum prominulo.
Longit. 28 millim.; lat. max. 38, min. 32.

This is a very handsome shell, and quite unlike any as yet described from New Guinea, with the exception of *H. brumeriensis*, Forbes. This is similarly sculptured, has a broad black expanded lip, but is not angled at the periphery or spirally banded in the same manner.

Helix (*Obba*) *oxystoma*.

Testa anguste umbilicata, depressa, in medio acute carinata, incrementi lineis striata, undique rugis subconcentricis, confertis, parvis sculpta, submalleata, flavescens, ad apicem rufescens, zonis duabus nigrescentibus plus minusve interruptis (una supra altera infra suturam) maculis sparsis, irregularibus, nigris rufisque peculiariter et insigniter picta; spira parum elevata, marginibus vix convexis.

Anfractus $4\frac{1}{2}$, celeriter accrescentes, sutura lineari sejuncti; primi $2\frac{1}{2}$ convexiusculi, prominuli, omnino rufescentes, cæteri minus convexi; ultimus supra et infra carinam leviter concaviusculus, antice subito valdeque descendens, paululum ante labrum leviter contractus. Apertura valde obliqua, undique fusco-nigra, triangularis; peristoma album, antice productum, nasutum, sursum versum, margine dextro leviter reflexo, columellari latiore, umbilicum partim obtegente, extremitatibus callo tenui fusco nigro junctis.
Longit. 23 millim.; lat. max. 41, min. 31.

H. Listeri (Reeve, Conch. Icon. fig. 122, *c–d*) gives some idea of the form of this species. It is, however, more narrowly umbilicated, quite differently sculptured, has a black aperture, and another style of coloration.

Helix (*Sphærospira*) *Gerrardi*.

Testa late umbilicata, globosa, obtuse conoidea, saturate purpureofusca, apertura labrisque cæruleo-cinereis; spira breviter conica, ad apicem obtusissima. Anfractus quinque, convexi, incrementi lineis striati, sutura lineari pallida, paulo profunda, discreti; primi quatuor superne granulis minutis, in seriebus obliquis regulariter dispositis, ornati, ultimus magnus, ventricosus, haud granulatus, antice aliquanto descendens. Apertura subhorizontalis, æque longa ac lata; peristoma crassiusculum, undique valde expansum et reflexum, margine columellari lato, callo tenuissimo pellucido labro juncto.
Longit. 37 millim.; lat. max. 48, min. 33.

The colouring of this species is very like that of *H. informis*, Mousson, which, however, is quite distinct in other respects. The granulation of the spire is very remarkable; and it is curious that it does not extend to the last whorl. This, however, may not always be the case, but merely an individual peculiarity of the single specimen at hand. The granules are arranged in such a manner as to form oblique series in two directions or in a criss-cross direction; they are excessively minute and crowded upon the topmost whorls, and gradually enlarge and become further apart as the shell grows. In addition to the sculpture already mentioned, there are indications on the body-whorl of a few shallow transverse indistinct sulci, with faintly elevated broad ridges between them, especially around the middle. The apex of this species is peculiar; for the nucleus coils in and downwards and is less raised than the second whorl.

XXVIII.—*Contributions towards a General History of the Marine Polyzoa*. By the Rev. THOMAS HINCKS, B.A., F.R.S.

[Continued from vol. x. p. 170.]

[Plates VI. & VII.]

XI. FOREIGN CHEILOSTOMATA (Australia and New Zealand).

Family **Cellulariidæ**.

SCRUPOCELLARIA, Van Beneden.

Scrupocellaria obtecta, Haswell. (Pl. VI. fig. 1.)

Zoarium of very stout habit, irregularly branched; internodes of moderate length, containing 7–9 cells. *Zoœcia* in two lines, alternate, rather short, broad above, narrowing downward; area oval, occupying about two thirds of the front; margin well raised, thin, a stout spine on each side a little below the top (one close to the *avicularium*, the other a little above the peduncle of the operculum); a large oblong shield-like operculum completely covering the area, surface smooth and glossy, with a bilobate hand-like pattern upon it, formed by a system of branching canals; peduncle broad; *lateral avicularium* usually small, with pointed mandible, occasionally much elongated, elevated, directed upward in the line of the cells, the mandible large, expanded towards the free extremity, which is carried out into a rather long slender spinous process, flanked by a shorter denticle on each side; just below the area a small, much raised *avicularium*, with pointed mandible directed obliquely downwards; *vibracular cell* erect, broad and rounded below, rising into a point above, the groove (beak) sloping downward from the summit to about the middle of the cell, the lower portion occupied by a very large foramen for the radical fibre, which is furnished with hooks; seta rather long, occasionally of enormous length (about twice the ordinary size). *Oœcium* (?).

Loc. Queensland (*Haswell*); Port Phillip Heads (*J. Bracebridge Wilson*).

I presume that this is the *S. obtecta* of Haswell, though his brief diagnosis, unaccompanied by a figure, is hardly sufficient for certain identification.

It is a fine handsome species, of robust habit, the large figured operculum forming a remarkable feature. A modification of the lateral avicularium, similar to that which I have

noticed in *S. varians*, mihi *, occurs in *S. obtecta*; but here the normal structure preponderates largely.

Scrupocellaria cervicornis, Busk.

Zoarium very slender, transparent, of a delicate pearl-white, branched, the branches very narrow. *Zoœcia* disposed in two lines, alternate, slender, tapering off downwards, surface smooth; aperture oval, with a very slightly thickened rim, occupying less than half the front; 4 or 5 marginal spines above, of which the lowest on the outer side is branched or antler-like (2 or 3 divisions); an operculum covering about two thirds of the area, somewhat enlarged above, narrowing off downwards, and subtruncate below, with a hand-like pattern arranged in a two-lobed figure; *lateral avicularium* very minute, at the base (between it and the margin of the cell) a very tall spine, curved slightly inward; below the area, rising on the inner side of it, a tall columnar process, bearing a much elongated *avicularium*, the slender subspatulate mandible sloping abruptly downwards from the summit (to which the base of the beak is attached), and tending obliquely across the lower portion of the cell towards the side of the branch; sometimes replaced by an *avicularium* of much smaller size and of the more usual form; *vibracular cell* rather slender, erect, not much expanded below, narrowing off towards the blunt upper extremity, groove sloping abruptly downwards from the summit to the base of the cell; seta very long (nearly three cells' length) and extremely slender; foramen small. *Dorsal surface* flattish, smooth, traversed by a very graceful sinuous line, marking the junction of the rows of zoœcia.

Loc. Off Cumberland Island (*Busk*); Singapore or Philippines (*Miss Jelly*).

In Busk's figure of *S. cervicornis* the front avicularia are represented as small and of the ordinary character. In the specimen on which the present diagnosis is based they have almost all assumed the very singular form which I have described above. The columnar support on which the appendage is borne is of remarkable height; and the elongate beak, with its spatulate mandible, drops abruptly from the summit to rest on the surface of the cell below. In the presence of the wonderful array of highly organized appendages on the front of the zoarium, we are not surprised to find the lateral avicularia atrophied and almost extinct.

* "Report on the Polyzoa of the Queen Charlotte Islands," Annals for December 1882.

A curious element of structure (not noticed by Busk) is the line of tall spines which fringes each side of the branch; it may probably act as a protective barrier. In this case all the appendages seem to me to have probably the same general function, and to be charged with the office of defending the polypide in various ways, and securing for it the conditions of healthy life. The opercular shield, the cleansing sweep of the setæ, the flapping of the mandibles, the fence of unyielding spines, all these seem to point in one direction.

In *S. cervicornis*, with its slender habit and delicate colour and texture, with its decorated shield and rich profusion of curious apparatus, we have certainly one of the most beautiful and most admirably equipped of its tribe.

Family **Bicellariidæ.**

STIRPARIA, Goldstein.

Gen. char.—*Zoarium* consisting of erect segmented stems, chitinous or calcareous, and of celliferous branches, which originate in more or less flabellate tufts close to the summit of the segments. *Zoœcia* of the normal Bicellarian type, turbinate, somewhat free above; aperture looking more or less upward, turned obliquely inwards, inferior portion of the cells subtubular. *Avicularia* articulated.

I have revised the characters of this genus, which was instituted by Goldstein for a remarkable Australian form, that it may include the kindred species which I am about to describe. There are some striking points of difference between the two, but none that would warrant their removal to separate groups. So far as the zoœcia are concerned, they are both typical *Bicellariæ*; the development of erect stems of peculiar structure, on which the celliferous branches are borne, is the one character which differentiates them both from the ordinary members of this genus. In *S. annulata*, Maplestone *, the stems are represented as composed of a "soft corneous" material, and the segments, though distinctly marked out by rather deep constrictions, are said not to be articulated. They are also very prettily annulated through a considerable portion of their length. In the form which I have to describe the stems are calcareous, divided into segments by well-marked corneous joints, and with a smooth surface. The internodes, too, instead of being of uniform length, are alternately shorter and longer; and it would seem that the celli-

* Journ. Microscop. Soc. Victoria, 1879.

ferous tufts are borne, if not exclusively, at least in a very great majority of cases, on the shorter only. These differences are interesting, but they are not of very marked significance.

The segments composing the stem are clearly abortive zoœcia; morphologically the stem is the equivalent of such structures as the stolon in the genera *Aetea* and *Eucratea*. In *Stirparia glabra* a large number of tubular fibres are given off from the lower internodes, originating in each case a little above the base; these, as they pass downwards, become closely attached to the stem, which is often thickly coated with them. At the bottom of the stem they become free and form a multitude of spreading rootlets.

Stirparia glabra, n. sp. (Pl. VI. fig. 2.)

Stems erect, calcareous, smooth, more or less branched, attaining a height of about ¾ inch, made up of alternate long and short segments, separated by corneous joints; the larger widening somewhat towards the top, and also slightly enlarged just above the base; surface smooth, polished, traversed on two faces by a fissure, which widens out towards the top, and is filled in by a transparent membranous (?) covering; the interposed smaller segments (about one third the length of the larger) rounded off below, at the top an obliquely truncate orifice on one side (from which celliferous tufts may originate), also furnished with fissures; stems attached by means of numerous tubular fibres given off from the inferior internodes; *celliferous branches* given off from the lateral opening at the top of the shorter segments, forming more or less flabellate tufts; the primary zoœcium in each tuft short, broadly turbinate, with a large terminal aperture and a number of marginal spines; from this two branches arise, which soon bifurcate. *Zoœcia* in two lines, alternate, suberect, turbinate; aperture occupying less than half the length of the cell, turned very decidedly inwards towards the central line, wide above, contracted below; margin raised, thin, the upper lip often extended into a spinous point on the outer side; four or five long, curved spines above, sometimes placed a good way down on the dorsal surface, a single spine near the bottom of the area at one side, tall, curved, bending inward; portion of cell below the aperture slender, tapering downward; a minute, articulated *avicularium* on the margin of the area at the bottom. *Oœcium* (?).

Loc. Geraldton, Western Australia (*Miss E. Gore*).

The avicularium is very sparingly present in the speci

..en which I have examined, and is, I think, the minutest which I have seen.

Several stemmed Cheilostomatous forms, some of which are extremely curious, have been brought to light in comparatively recent times; they are *Kinetoskias*, Kor. & Dan., also a Bicellarian group with four species, and *Rhabdozoum*, mihi, which is referable to the Eucratean family, in addition to the present genus. In most of these forms the stem probably represents a modification and adaptation of the structure known as the "radical fibre;" in the present case, as I have already stated, it is composed of aborted cells.

Stolonella, nov. gen.

Gen. char.—Zoarium consisting of a creeping stolon, and zoœcia distributed upon it. *Stolon* chitinous, free in itself, but attached at intervals by adhesive branching disks, which originate from short stolonic offsets, jointed, more or less branched. *Zoœcia* erect, scattered, always developed close to a joint, attached to the stolon by the pointed lower extremity of the dorsal surface, subcalcareous, boat-shaped, aperture occupying the whole front, closed in by flattened spinous ribs, united together; orifice terminal.

The true stoloniferous character of this form seems to call for its separation from *Beania*, as represented by our British *B. mirabilis*. The cells in the latter species are borne at the extremity of a slender pedicel, which takes its origin on the dorsal surface of a neighbouring cell; and it is in this way only that the members of a colony are united. There is no common stolon to which the individual zoœcia are jointed. Each cell is *attached* by means of a radical tube emitted from its dorsal surface, which spreads itself out into a fibrillated disk and holds it to its place. But in *Stolonella* the plan of structure is quite different and much less simple. The zoœcia are borne on a distinct stolon, as in *Eucratea* or *Valkeria*, and are attached by the extremity of the dorsal surface to a slight prominence on the creeping stem. The stolon is not adhesive, as in the genera just mentioned, but is fixed by a special apparatus of disks developed at intervals along its course. It is regularly jointed, and close to the joint a branch is given off at right angles on each side. These branches are occasionally both of them very short, bearing at the extremity an adhesive disk; more commonly one only is arrested in development and carries a disk, the opposite one lengthening out into a jointed stolon, like that from which it originates, and bearing a line of cells. This structure is evidently a derivative from

the simpler and more primitive form which we have in *Beania mirabilis*.

The zoœcium of *Stolonella* bears a general resemblance to that of *Beania*; but there has been an important modification of one element. The spines are converted into flattened ribs, which bend in over the aperture, meeting in a central line, and are united by a membranous or membrano-calcareous expansion, so as to form a continuous wall.

Stolonella clausa, n. sp. (Pl. VII. fig. 6.)

Stolon jointed at regular intervals, opposite branches given off close to each joint, one (usually) rudimentary and bearing a branched disk at its extremity, the other celliferous and itself branched. *Zoœcia* originating close to the lateral branches, jointed to a short process, elongate, erect, boat-shaped, slender as seen in front, and tapering slightly towards the base; dorsal surface smooth and highly glossy, curved outward below; on each side of the aperture 11–14 flat and rather broad spinous ribs, which bend in over the opening and meet in the centre, united together laterally, the enlarged bases of the spines forming a kind of pattern running the length of the cell; on each side of the orifice two stout, erect, pointed spines.

Loc. Creeping over *Fucus*, Geraldton, West Australia (*Miss E. Gore*).

The cells of *S. clausa* bear a certain amount of superficial resemblance to those of *Beania australis*, Busk (B. M. Cat. pl. xvi. figs. 1–3). The diagnosis of the latter is useless for identification in such a case, as it merely gives the number of the costæ; but if we are to trust the figure in the 'Catalogue,' the two forms are undoubtedly distinct. The cells of *B. australis* (to take a single point) are represented as attached by the whole of a rather broad base to a decumbent stem; whereas those of the present species are jointed by the extremity of the dorsal surface, which terminates in a blunt point, to a process from the stolon. The contour of the two below is quite dissimilar. A suberect tubular process is also figured by Busk as rising from the stem near the base of the cell; but nothing of the kind is present in *Stolonella clausa*.

The adhesive disks are a very marked characteristic of the present form, and would hardly have escaped the notice of so practised an observer as Mr. Busk. They are commonly bilobed, consisting of two disks joined together.

Sometimes the branching is luxuriant and the zoœcia are rather densely clustered. The lateral offshoots exhibit exactly the same structure as the main lines of stolon, and give off in the same way their branches and disk-bearing processes.

Stolonella clausa may safely be pronounced one of the loveliest of Polyzoa.

Family Cellariidæ.

FARCIMIA, Pourtales.

Gen. char.—*Zoarium* calcareous, erect, branching; stem and branches composed of segments united by corneous joints. *Zoœcia* arranged in series round an imaginary axis with elevated margins and a depressed area, which is more or less covered in with membrane.

The genus, instituted by Pourtales and adopted by Smitt*, includes forms with a Cellarian habit and a Membraniporidan cell. The type species is the *Farcimia cereus* of Pourtales.

Farcimia appendiculata, n. sp. (Pl. VII. fig. 4.)

Zoarium erect, dichotomously branched, internodes of moderate length (usually containing four cells on each face), narrowed at the base, joints composed of two corneous tubes. *Zoœcia* arranged in four series, alternate, arched above, subtruncate below, expanded at the sides, margin raised and thin; the whole aperture covered by a transparent membrane, except a small portion at the base, which is closed in by a rather stouter material. On each side, just below the top, an *avicularium*, occupying the space between the raised margins of the contiguous cells, elongate, subimmersed, tapering off below, stretching obliquely downwards, the upperside occupied by a slightly depressed area, covered in by membrane, at the top the beak and mandible, the former small, very slightly bent at the tip, mandible bluntly triangular, directed outwards—the *avicularia* of the neighbouring rows forming a line between the cells; commonly the membranous covering of the avicularian area extended into an erect process, broad at the base and running out into a sharp point above (Pl. VII. fig. 4 *b*). *Oœcium* terminal, rounded, immersed.

Loc. Port Phillip Heads (*J. Bracebridge Wilson*).

The avicularia are the striking feature of this species. In structure they seem to resemble the lateral appendage of the genus *Scrupocellaria*. They are remarkable for their size; and from the alternate disposition of the cells they fall into regular longitudinal rows, intercalated between the series of zoœcia. The membranous appendages are present in large numbers; but the examination of dead specimens merely does not afford the means of determining their function.

* 'Floridan Bryozoa,' part ii. p. 2.

Family **Myriozoidæ** (part.), Smitt.

SCHIZOPORELLA, Hincks.

Schizoporella cinctipora, n. sp. (Pl. VII. fig. 3.)

Zoœcia ovate, quincuncial, flattish, divided by raised lines; surface reticulate, strongly calcified, glossy (the sheen due in great part to the shining membranous covering of the reticulations); orifice of about equal height and width, arched above, lower margin straight, with a small rounded loop-like sinus in the centre, the entrance guarded by two raised points; peristome much elevated and slightly thickened, forming an enclosure round the primary orifice (which appears immersed); close to the lower margin of the primary orifice at one side a rather large round *avicularium*, placed on the summit of a low rounded mamilla, with smooth surface. *Oœcium* rounded, broader than high, often subimmersed, surface smooth and silvery or slightly roughened, with a number of large circular punctures, the arch of the secondary orifice carried across the front of it.

Loc. New Zealand (*Miss Jelly*).

Family **Escharidæ** (part.), Smitt.

LEPRALIA, Johnston (part.).

Lepralia foraminigera, n. sp. (Pl. VII. fig. 1.)

Zoœcia ovate (much irregularity in shape), quincuncial, very slightly convex, sutures distinct but not deep; surface perfectly smooth, the front wall pierced by several foramina, varying in shape, size, and disposition—sometimes of large size, sometimes minute, the openings of which are closed in by a chitinous membrane and have a slight edging; orifice broader than high, arched above, a constriction on each side a short distance above the lower margin, which is curved outward and very slightly prominent; the oral operculum stout, dense, and of a rather dark horn-colour; peristome not elevated. *Avicularia* none. *Oœcium* rounded, not prominent; surface smooth, dense, waxy, the upper part occupied by a large foramen with membranous covering.

Primary (or *central*) *cell* expanded below, narrowing towards the oral extremity, the whole area covered in by a dark dense membrane; no spines.

Loc. New Zealand, forming large suborbicular brown crusts (*Miss Jelly*).

The marginal cells in an early stage have the front wall wholly membranous, with the oral valve at the top of it. A thin calcareous covering gradually forms over the membrane, the calcification, which is feeble, being interrupted by frequent lacunæ.

Lepralia rectilineata, n. sp. (Pl. VII. fig. 5.)

Zoœcia large, elongate, rectangular, disposed in regular linear series, moderately convex; surface whitish and silvery, punctured, the punctures disposed in lines which run from the sides towards the centre, sometimes separated by stony ridges; orifice large, expanded and suborbicular above, constricted a short distance above the lower margin by two prominent points, below the constriction much contracted, lower margin nearly straight, slightly raised in the centre; peristome scarcely elevated; six (normally) marginal spines, disposed three on each side above; the opercular plate filling in the lower part of the orifice (beneath the constriction) much thickened and prominent; sometimes a small raised *avicularium* a little below the inferior margin, with somewhat elongate and rounded mandible directed downwards, often several similar *avicularia* scattered over the front wall; on each side of the orifice at the top a small *avicularium* of the same kind, the mandible directed towards the side, sometimes replaced by a much elongated form (Pl. VII. fig. 5 *a*) with a slender subspatulate mandible. *Oœcium* (?).

Loc. New Zealand (*Miss Jelly*).

Mucronella, Hincks.

Mucronella bicuspis, n. sp. (Pl. VII. fig. 2.)

Zoœcia ovate, quincuncial, very prominent, the wall sloping steeply up from the sides to the suboral region, sutures deep, surface smooth; orifice very large, subquadrangular, with a slightly raised thin margin, bearing on each side just above the lower margin an oval *avicularium*, with rounded mandible directed upward, a denticle projecting inward on each side just under the avicularium, and in the centre of the lower margin a broad bicuspid process; immediately behind it rises a tall sharply pointed mucro, the spreading base of which is inclosed by a white line; the lower portion of the cell usually with a line of large punctures placed a little within the margin, areolated, the punctures sometimes irregularly scattered. *Oœcium* of a beautiful pearly white, almost semicircular, somewhat flattened in front, thickly covered with minute

granulations, a raised line round the base, the front margin slightly prominent.

Loc. Hawkes Bay, New Zealand (*Miss Jelly*).

The following species are not included in Hutton's 'List of New Zealand Polyzoa':—

Catenicella crystallina, Wyville Thomson.

Bluff Harbour, south of Otago, low-water mark (*Prof. Coughtrey*).

Caberea grandis, Hincks.

Otago (*Prof. Coughtrey*).

EXPLANATION OF THE PLATES.

Plate VI.

Fig. 1. *Scrupocellaria obtecta*, Haswell. Front view of zoœcia. 1 *a*. Dorsal surface. 1 *b*, 1 *c*, 1 *d*, Lateral avicularium, showing modifications. 1 *e*. Natural size.

Fig. 2. *Stirparia glabra*, n. sp., highly magnified, showing the stem and a celliferous tuft *in situ*. 2 *a*. Portion of stem, showing bifurcation. 2 *b*. Portion of a celliferous branch. 2 *c*. Natural size.

Plate VII.

Fig. 1. *Lepralia foraminigera*, n. sp.
Fig. 2. *Mucronella bicuspis*, n. sp. 2 *a*. Zoœcium with ovicell.
Fig. 3. *Schizoporella cinctipora*, n. sp.
Fig. 4. *Farcimia appendiculata*, n. sp. Portion of an internode.
Fig. 4 *a*. *F* ovtate (m*ndiculata*, n. sp. Natural size. 4 *b*. One of the
slightly convexocesses connected with the avicularium.
... *gata*, n. sp. 5 *a*. One of the elongate avicularia.
n. gen. and sp.

XXIX.—*Description of a new Genus of* Cœciliæ. By G. A. Boulenger.

Epicrionops, g. n.

Squamosals separated from parietals. Two series of teeth in the lower jaw. Tentacle minute, flap-shaped, close to the anterior border of the eye*. Latter distinct. Cycloid imbricated scales imbedded in the skin.

* I could not give a better representation of this tentacle than the figure 1 (representing a larva of *Ichthyophis glutinosus*!) of the plate accompanying Peters's memoir on the *Cœciliæ*, in Monatsb. Berl. Acad. 1879.

Epicrionops bicolor, sp. n.

Teeth small; both rows of mandibular teeth well developed. Snout rounded, scarcely prominent; the width of the head between the eyes does not quite equal the distance of the eye from the end of the snout. Body subcylindrical, slightly depressed, with 245 very distinct, complete circular folds. Anal opening longitudinal, elongate. Tail pointed, compressed, as long as the head. Dark brown; a broad yellow band along each side of the belly, nearly as broad as the interspace, commencing from the mouth, uniting in front of the vent, and occupying the lower half of the tail. Total length 225 millim., greatest diameter of body 9 millim.

In general physiognomy and colour, this highly interesting form resembles *Ichthyophis glutinosus* of the East Indies, from which it is generically distinguished by the structure of the tentacle and the well separated squamosal and parietal bones. It is remarkable in the retention of several of the larval characters of *Ichthyophis*, viz. the position of the tentacle, the elongate anal cleft, and the relatively long and compressed tail.

One specimen was collected by Mr. Buckley at Intac, Ecuador.

XXX.—*The 'Challenger' Amphipoda.* By the Rev. THOMAS R. R. STEBBING.

THE following preliminary descriptions are published "by permission." The work of arranging, describing, and figuring the whole group is likely to take some time. In the meanwhile it may be of interest to students of this branch of natural history to have a brief account of some of the more striking forms that have been discovered. The details now given are intended to afford some notion of the external appearance of the specimens, and to distinguish them from their congeners previously known. There are naturally many points of interest which do not come within the limited scope of this intention. These are reserved for publication in the completed work. In the nomenclature here used the classification of A. Boeck has been followed.

Family **Gammaridæ**.

Subfamily ŒDICERINÆ.

Acanthostepheia ornata, n. sp.

The rostrum is produced beyond the first joint of the upper

antennæ, and is almost entirely occupied by the elongate eyes, which are only separated by a linear ridge. All the segments of the pereion and pleon are carinate. In the pereion the hinder margin of each segment is adorned all round with teeth alternating in size, the central one of the carina being the largest. This fringe has an appearance like the projecting edges of the septa in many corals. The number of the teeth varies from nine to seventeen. The seventh segment has a second row in advance of the hinder margin; the other segments have also some lateral tubercles in this position. The first pleon-segment has the fringe of teeth on the hinder margin, but very small; in front of this row it has a large median tooth, flanked by two small teeth or tubercles on each side, set divergently. The next segment has a long central ridge, with the flanking tubercles, but no teeth on the hinder margin. The third segment, dorsally much longer, has the central ridge, but no other ornament; so also the fourth; the fifth and sixth are very small. The epimera and lower borders of the first three pleon-segments are fringed with hairs. In the upper antennæ the fourth joint of the peduncle is longer than the fifth. The last three epimera are not acuminate, in disagreement with the description of the genus given by A. Boeck.

Œdiceropsis rostrata, n. sp.

This species agrees closely with *Œdiceropsis brevicornis*, Lilljeborg, in the antennæ, the epimera, shape of gnathopods, relative lengths of pereiopoda, general shape of telson, and to a large extent also in the mouth-organs. Contrary, however, to the generic character of *Œdiceropsis*, it has a large rostrum, apparently carrying the eyes. It would, notwithstanding this, in my opinion be better to re-unite *Œdiceropsis* with *Œdiceros* on account of this connecting link than to separate the present species generically from *Œdiceropsis brevicornis*.

In the mandibles the second joint of the palpi is shorter than the third. In the maxillæ of the second pair the outer plate is very little narrower than the inner.

The almost quadrangular telson has a very minute distal emargination.

Subfamily EPIMERINÆ.

Epimeria conspicua, n. sp.

A median carina runs along the back from the first pereion-segment to the fourth segment of the pleon. On the first two pereion-segments it is obtuse and little pronounced, but

gradually attains its greatest development in the great laminar backward-directed processes on the first three segments of the pleon. The subdorsal carinæ are formed by single tubercles on either side of the pereion-segments, while on the first three pleon-segments the main tubercle is attended by a group of smaller ones. The lower hinder angles of the pereion-segments are rounded, produced backwards, and are a little prominent, thus forming a sort of lateral carinæ, which are continued by pointed tubercles on the first three pleon-segments. These last-mentioned segments also have their lower hinder angles produced into sharp points. The second pleon-segment has also a produced point at the basal end of the lower margin. The last two joints of the peduncle of the lower antennæ are unequal in length. The pereiopoda have small spines. In other respects the creature resembles the larger and more northern species, *Epimeria loricata*, G. O. Sars, so far as that is described, and may possibly be only a variety of it.

Acanthozone tricarinata, n. sp.

Head almost concealed; antennæ with some of the peduncle-joints variously dentate. A large triple carina the whole length of the pereion, formed by long outstanding processes. On the first segment the central process is double, one branch extending forwards. The segments have also the hinder margin transversely carinate. The first two epimera are simple, acuminate below; the five that follow have large processes above similar to those on the segments. The third and fourth epimera curve backwards below to a sharp point; the fifth and sixth are rounded at this part, but have an angle below on the front margin.

The central carina is continued with processes of various sizes along the pleon, the lateral carinæ being also more or less represented.

The last three pereiopoda have the first joint with its hinder margin carinate, not produced into an angle above, as in *Acanthozone cuspidata*, Lepechin, but produced downwards in a rounded lobe over the second joint; the third and fourth joints have the lower hinder angle much and sharply produced downwards.

Subfamily *Gammarinæ*.

Amathillopsis australis, n. sp.

A median carina runs from the head to the telson. Only the last three segments of the pereion and the first three of the pleon have the carina produced into a spine. Of the epimeral

plates the third and fourth are the longest; and these are both acute. The third articulus of the mandible-palp is considerably longer than the second. The telson is slightly emarginate, broader at base than distally, nearly equal in length to the peduncles of the last uropods. In many points it is nearly allied to *Amathillopsis spinigera*, Heller, and *A. affinis*, Miers.

Family **Leucothoidæ.**

Subfamily *Stegocephalinæ.*

Andania gigantea, n. sp.

Two specimens of this creature have been examined. One is $1\frac{1}{20}$ inch in length by $\frac{17}{20}$ in depth, the other $2\frac{1}{2}$ inches in length by $1\frac{1}{2}$ in depth. These dimensions contrast strangely with the small forms of the other species of this genus.

The first segment of the pereion is as long as the next two united. The fourth epimerum is a little broader than deep, of much less size relatively to its segment than the same part in *Andania abyssi*. The first joint of the flagellum in the upper antennæ is much longer than the peduncle, a little longer than the remaining articuli of the flagellum, and likewise a little longer than the secondary flagellum.

The third pleon-segment has a dorsal lobe projecting backwards; the fifth pleon-segment, on the contrary, has the corresponding portion of its margin much excavated. The sixth segment is slightly emarginate to receive the minute telson. The telson has, contrary to the generic character, a small distal slit.

The gnathopods and pereiopods are very small compared with the size of the animal.

Subfamily *Iphimedinæ.*

Iphimedia pulchridentata, n. sp.

Head with depressed rostrum and bidentate sides; eyes round, a little prominent. In the upper antennæ the first articulus has a tooth near the base, and three distally; the second articulus has a long distal tooth projecting beyond the simple third articulus. In the upper antennæ the last four joints of the peduncle are distally toothed. Of the pereion-segments the first five have the hinder angle sharply toothed, the sixth and seventh have the posterior margin divided into six large processes, the seventh has a marked transverse dorsal depression. In the pleon the first two segments have eight marginal processes, four on either side of the central dorsal

elevation. The third segment has a similar dorsal tooth with three processes on either side; the fourth has only the dorsal process; the fifth is simple; the sixth is produced into sharp angles behind the insertion of the telson.

The first three epimera are bidentate below, the last three are posteriorly bidentate, the fourth widely excavated below, with the hinder tooth much above the anterior one. The third joint is produced in all the pereiopoda, in the last three the fourth joint also, in each of which the first joint is a flattened plate with the lower and hinder margin conspicuously cut into variously sized teeth, six in each of the first two, seven in the last. The peduncles of the last uropods are short and broad, acutely produced behind. The telson is concave above, rather deeply emarginate, ending in two sharp points.

Iphimedia pacifica, n. sp.

Head with depressed rostrum and bidentate sides. In the upper antennæ the second and third articuli, in the lower the third articulus, are denticulate. The last segment of the pereion and first two of the pleon dorsally bidentate. All the segments of the pereion have the lower margin produced acutely backwards, the seventh segment conspicuously. This is the case also with the last three epimera, the first three and the last pleon-segments. The first three pleon-segments have likewise a medio-lateral tooth, that on the third being bent upwards and serrulate below. The last three pereiopoda have the first joint with a serrate margin, dilatedly rounded above, the lower hinder angle produced into a tooth.

The telson is square in general form, emarginate, with a distal tooth at each side.

Family **Caprellidæ**, Dana.

Dodecas elongata, n. g. et sp.

Gen. char.—The mandibles having an elongate triarticulate palp. Six pairs of feet attached to the pereion, the fourth segment having none. Branchial vesicles at the base of the second gnathopods, the first pereiopods, and attached to the footless fourth pereion-segment, the rudimentary pleon having two pairs of biarticulate appendages.

Spec. char.—Body smooth; eyes prominent; first two segments of pereion very long and slender in the male, much shorter and somewhat thicker in the female. The wrist or fourth joint of the second gnathopods very long in the male, short in the female. The first pereiopods exceedingly slender; the third pereiopods also slight, only four-jointed.

PROCEEDINGS OF LEARNED SOCIETIES.

DUBLIN MICROSCOPICAL CLUB.

April 27, 1881.

Spinulose Globigerina.—Professor E. Perceval Wright showed mounted examples of *Globigerina* remarkable for the great length of their superficial spines, with others where these were much reduced, and, finally, ordinary examples where they were absent.

Zygospore of a minute Cosmarium for the first time observed conjugated, and named Cosmarium Wrightianum.—Mr. Archer exhibited the zygospores of a rather common minute *Cosmarium*, but only now detected conjugated at Castletown Berehaven by Dr. E. Perceval Wright, to whom Mr. Archer owed this the only slide secured. This form is minute, smooth; semicells oblongo-elliptic, ends somewhat retuse; but this feature is so slight as to be very readily overlooked. It has of course resemblances to several of the more minute forms—*Cosmarium bioculatum*, *C. tinctum*, *C. Schliephackianum*, *C. pusillum*. But the zygospore of these, so far as is known, differs much from that of the present, except *C. tinctum*; but then the differences of these two species as regards the mature form are sufficiently striking, the latter being still more minute, and having evenly elliptic semicells of a reddish colour. The zygospore in the present form is tetrahedral, the angles bluntly rounded; in *C. tinctum* it is sometimes so, but more often subelliptic; whilst, as is seen, the mature forms differ in size, outline, and colour. This might fitly stand as *Cosmarium Wrightianum.*

Histology of Metatarsus of Fœtal Puppy.—Mr. B. C. Windle showed sections through the metatarsus of a ten-day fœtal puppy, presenting a perfectly normal number and arrangement, thus differing from the section of the manus of the same puppy, exhibited to the Club at the last October meeting, which presented an extra-interosseus muscle.

May 19, 1881.

Chalara cocos, n. s., Pim.—Mr. Greenwood Pim exhibited specimens of a form of *Chalara*, a genus of Torulacei. This form, which is probably undescribed, being quite distinct from *Chalara fusidioides*, grew inside a cocoa-nut, and consisted of a delicate mycelium, giving off numerous slender threads, becoming multiseptate and breaking up into short joints, apparently nearly hyaline and very minute. Owing to this form having occurred amongst *Aspergillus* and other moulds, it was impossible to arrive at any particulars as to its general appearance or habit. Awaiting further investigation, Mr. Pim would record the form in question as *Chalara cocos.*

Pollen of Sarracenia rubra and S. flava and Hybrid Form.—Pro-

"fessor M'Nab exhibited pollen of *Sarracenia rubra* and of *S. flava*, as well as of the hybrid form *S. rubra-flava*, raised at Glasnevin Garden by the late Dr. Moore, and known in gardens as *Sarracenia Popei*. The pollen of the hybrid exhibited a nearer resemblance to that of *S. rubra*, the male parent, than to that of *S. flava*.

Exceptional Growth in Polysiphonia.—Dr. E. Perceval Wright exhibited examples of an exceptional growth in *Polysiphonia*, giving off root-like bunches of processes from the upper branches, these radiating in various directions. Dr. Wright observed that Mr. Frank Darwin has recently, in a paper on the theory of the growth of cuttings, called attention to Vochting's statement ('Organbildung im Pflanzenreich') that "a living vegetative cell which is capable of growth has not a specific and unalterable function," and that "the function assumed by a cell depends on the morphological position which it occupies in the life-unit as the most important condition;" and as to the production of stem and root, he refers this to an innate hereditary tendency in the tissues of plants (morphological force). While Dr. Wright had long taught the essential doctrine embodied in Vochting's work as true of the cells of the true caulome- and root-producing plants, he had always thought that it would not apply to the thallome-producers; here the morphological force does not always show an innate tendency to the production of organs in morphologically determined positions. In confirmation he exhibited *Polysiphonia urceolata*, in which the root-like processes (cells) are thrown off in all directions.

Histology of the Mouse's Nose.—Dr. Reuben Harvey showed some sections from the nose of a mouse demonstrating the free communication between Jacobson's organ and the nasal cavity. The communication in question had been observed by Dr. Harvey before a similar communication in the guinea-pig observed by Klein had been published. Dr. Harvey had since demonstrated a somewhat similar state of things in the kitten. Dr. Harvey also showed some sections from an embryo rat showing the development of the organ of Jacobson.

Hæmoglobin Crystals from Cat.—Dr. Harvey further showed a specimen of hæmoglobin crystals from the cat, obtained by a mo- -cation of Gscheidlen's method, the whipped blood being -ered laky by the addition of water and filtered before being h- -etically sealed in tubes. By this method the occurrence of granular débris is avoided.

Problematic hyaline, stipitate, attached, club-shaped Structure, with Apical Orifice and Green Contents.—Mr. Archer exhibited an organism, occasionally presenting itself to notice, the exact nature or position of which could not be determined, coming thus under the category of "problematic" structures. To some extent it might be regarded as coming near or at least resembling *Colacium* found on Entomostraca, fresh examples of which latter he was fortunately able to place side by side with the present puzzling structure. This

presents a club-shaped figure, and occurs seated on Confervoids, attached thereto by the base of the attenuated lower prolongation; it is colourless and hyaline, with the exception of a centrally posed, often subtriangular, green mass, occupying the centre of the more swollen part of the club-shaped hyaline structure. The upper and rounded terminal extremity possesses at the very apex a circular sharply marked foramen, surrounded by a slightly thickened rim. Were a flagellum seen to protrude through this, the organism might be compared to a stipitate or attached form allied to *Chlamydomonas* &c.; but not a trace of any flagellum could ever be detected. It must not be at all supposed that this could be a form of *Characium*, or still less a young one-celled plantlet belonging to either *Œdogonium* or to *Chætophora*; such could not for a moment be confounded with the organism, whatever it may be, to which attention is now drawn, the true nature of which must unfortunately remain doubtful; it is probably algal. Although it is rather widely distributed, it still is decidedly rare and in reality but very seldom encountered.

June 16, 1881.

Locomotive State of Bacterium rubescens, Lankester, *and a companion form, likewise active.*—Mr. Archer showed that actively moving state of *Bacterium rubescens*, Lankester, to which he had once before drawn attention, then as probably a new form of Nägeli's genus *Cœlosphærium*, in which the globular congeries of cells keeps fitfully rolling about, more or less actively. In this form indeed the appearance of the cells, with their red circumference and blue centre, was precisely that of the (so-called) *Bacterium rubescens*; and, as Mr. Archer showed on another slide, it was precisely that of an indubitable filamentous and oscillatoriaceous alga—so much so that the main difference was, in the cells themselves, but one of size, apart, of course, from the quite different mode of build-up of the plant itself in each instance. Doubtless those who hold *Bacterium rubescens* to be truly a *Bacterium* proper would regard the condition now shown as the parallel of the glœogenous state of *Bacterium termo*, only that the mucous matrix is not so strongly developed in the present form; but the glœogenous state of *B. termo* does *not move about* as an aggregate mass. Here indeed no cilia or flagella whatever can be detected, nor can any *modus operandi* of the movement be made out under the microscope; but this remarkable action all the more strikes the observer with wonder. Mr. Archer was able on the present occasion to draw attention to a companion form for the one just adverted to, one in which the constituent cells were of a wholly different aspect—more minute, more rotund, quite homogeneous, all over of a very pale phycochromaceous tint, and bound together in little clusters, these, however, often of only, say, four cells up to, say, a dozen or more. Now these were clearly not the same thing as the former; for in all the phases of *B. rubescens* the cells evince a resemblance, and seem to maintain their characteristic appearance; but these little congeries of still more minute cells

were endowed with the same remarkable power of rolling about hither and thither. May these latter have been incipient glœogenous states of *B. termo*, and, though bound together, still retaining their locomotive power? If it be true that all *Bacteria* possess a flagellum at one or both poles, does each constituent cell of these *Cœlastrum*-like masses own a proper flagellum? One could, Mr. Archer thought, hardly look at the organisms now exhibited under the microscope and not take them to be veritable Algæ—Phycochromaceous Algæ.

Adventitious Ramifications of Callithamnion.—Dr. M'Nab drew attention to an example of *Callithamnion* in which certain adventitious root-like dependent branches were given off from the axils of the ordinary branches, and these, in place of remaining external, passed inwards and became incorporated with the structure of the stem of the alga, maintaining, however, still their individuality as they passed thus downwards for a considerable distance.

Artery from "tubercle" of Leprosy.—Mr. P. S. Abraham, M.A., B.Sc., F.R.C.S., exhibited a section of an artery from a so-called "tubercle" of leprosy, showing obliteration of the lumen and enormous thickening of the walls, which are closely studded with an irregularly formed variously sized cellular growth. By the confluence of such altered arteries the leprous thickening in some cases is in great measure made up.

Histology of Spinal Cord of Acanthias vulgaris.—Professor Mackintosh exhibited a cross section of the spinal cord of the Picked Dogfish (*Acanthias vulgaris*) taken from the dorsal region. The grey matter was seen to be arranged in a somewhat T-shaped fashion; and the axis-cylinders in the white substance were remarkable for their size. The central canal was also particularly well defined. The preparation was stained with blue-black and logwood, according to Dr. Harvey's method.

Section of Trap from Sutherlandshire.—Prof. Hull, F.R.S., exhibited a thin section of a sheet of trap which is found penetrating the Lower-Silurian Limestone of Loch Assynt, in Sutherlandshire, near Inchnadamff. It is a kind of diorite, consisting of short crystals of hornblende, a little triclinic felspar, occasional small grains of quartz, and of magnetite. The crystals of hornblende are remarkable for the perfection of their crystalline form, and under the polariscope present a vivid play of colours on rotating the analyzer. The author considered it unusual to find a hornblendic rock associated with limestone in the manner of this intrusive sheet.

Section of Reddish Felstone Porphyry.—Prof. Hull also exhibited a section of reddish felstone porphyry from the neighbourhood of Newtown Stewart, containing several crystals and groups of apatite, showing various sections of the hexagonal prism according to the plane of the section. The felsitic paste was seen with a $\frac{1}{8}$ ob-

jective to contain numerous exceedingly small colourless prisms of apatite, as the author supposed. It might be inferred that in this rock the proportion of apatite is unusually large.

Treble Staining with Picro-Carmine and Iodine Green.—Mr. B. Wills Richardson exhibited a cross section taken with the freezing microtome from a kitten's tail, treble-stained with picro-carmine and iodine green, and mounted in Klein's damar solution. He (Mr. Richardson) observed that sections from the tails of the rat, mouse, or the kitten, when treble-stained successfully, form very beautiful and instructive specimens. In the one he exhibited, for example, there were distinctly differentiated sections of tendons, muscles, hairs in their follicles and even projecting from the opening of each of the exposed hair-shafts, and ossifying cartilage with the recently formed bone. He would not allude to any of the other structures to be found in the section, as they had not been sufficiently tinted for satisfactory demonstration with low objectives. Mr. Richardson further observed that he was experimenting with malachite green as a substitute for the iodine green, and hoped to exhibit some sections from the same tail at the next meeting of the Club stained with the malachite and picro-carmine. Although stainings of animal tissues are not, generally speaking, seen to the best advantage with ordinary artificial light, they may nevertheless be greatly improved by passing the light through thin muffed glass.

July 21, 1881.

Periœsophageal Membrane of Frog. Dr. Reuben Harvey exhibited some gold-stained specimens of the periœsophageal membrane of the frog.

The membrane in question is the outer wall of a serous cavity or lymph-space, through which the œsophagus passes. The existence of this lymph-space is not generally known. Although he asked several persons about it, he had found no one who knew it except Prof. Macalister; and even he was unable to give Dr. Harvey any reference to an account of it.

Dr. Harvey had discovered the membrane for himself some three years ago. And the following method by which its existence was accidentally made known to him serves to demonstrate its relations excellently. If a sharp-pointed canula be carefully inserted into the œsophageal *serosa* at either end, but preferably at the upper end, where it is reflected onto the lungs, it is possible to inflate a cavity nearly globular in shape, which shows that the *serosa* here is really a double layer, there being a visceral layer which is intimately bound to the *muscularis* of the œsophagus, and a free outer layer, which is the membrane in question. The cavity in the case of *Rana temporaria* and *Rana esculenta* is traversed by few, if any, trabeculæ except at the back; but in the common toad and in *Hyla arborea* the cavity is so beset with trabeculæ as to be hardly discernible. The outer membrane is a very beautiful object for histological work. It is a very delicate transparent membrane, and

may be prepared in considerable extent with great ease. Both surfaces are covered with endothelium. If the outer be brushed over before staining with silver nitrate, the endothelium on the interior of the blood-vessels is very beautifully shown; and the preparations made in this way are more satisfactory than those got by injection. The blood-vessels in the membrane are numerous, of small size, and arranged in a plexiform manner. They are accompanied by nerves, for the most part non-medullated, which branch repeatedly; and from these may be traced the most delicate fibrils passing out into the tissue, and running into the spaces between the connective-tissue corpuscles.

Sections illustrating Triple Staining.—Mr. B. Wills Richardson exhibited (1) several sections taken from the tail of a recently born kitten, (2) a cross section from the larynx of a human nine-month fœtus, and (3) a longitudinal section from an enlarged uvula excised some months previously. With all of these sections picro-carmine, iodine, and malachite-green dyes were used as stains. The sections were mounted in Klein's damar solution, and were illuminated by artificial light transmitted through a thin piece of colourless muffed glass, which, by diffusing the light, greatly improved the appearance of stained tissues.

Dipterous Larvæ beneath the Human Skin.—Dr. Walter G. Smith exhibited some larvæ, of which the following was the history:—A girl, aged 12, presented herself with an ovoid swelling on the outer side of the right ankle, causing her some pain and uneasiness in walking. This swelling gradually shifted its position, and slowly moved up the leg, thence towards the right axilla, then down to the elbow, and finally settled on the back of the neck. In this situation a small dark spot appeared; an orifice formed; and when pressure was made around this opening, a white grub, nearly an inch in length, protruded and escaped along with some unhealthy pus. Several other similar swellings developed upon subsequent occasions under medical observation; and the medical man extracted other grubs, exactly similar to the first specimen. No cause could be assigned for these curious phenomena. The larvæ were pronounced by competent authority to belong to a dipterous insect, although the genus could not be satisfactorily determined. There was no proof of the existence of an Œstrus peculiar to man alone.

Alcyonarian Spicules.—Dr. E. Perceval Wright exhibited some spicules of an Alcyonarian from the 'Challenger' collection, which, from their long needle-like shape, seemed to differ very much from those belonging to any of the fixed Alcyonarians. These spicules were of various lengths, of a pink colour, calcareous, and to be found in large numbers in the ectoderm of the stem and polyps. The external appearance of the species indicated an affinity to *Xenia*.

Euastrum Armstrongianum, Arch., *a very rare Form, exhibited.*—Mr. Archer showed examples of the extremely rare and very local

form *Euastrum Armstrongianum*, a species not yet detected out of Connemara. It occurs in deep and limpid water, the ponds being such as are kept constantly at a maximum degree of fulness from its bottom "spring." This is not a very pretty, but exceedingly well marked and distinct form.

Histology of Foot of Solen.—Mr. P. S. Abraham, F.R.C.S., M.A., B.Sc., showed, under a low power, transverse and longitudinal sections, taken near the apex of the foot of *Solen*, with a view to demonstrate the arrangement of the muscular tissue of that organ. The unstriped muscle-fibres are arranged in layers and bundles which have broadly the following distribution:- Beneath the subepidermic loose tissue is a layer of transverse or circular fibres, which are particularly well marked at the sides of the foot. Then comes a thick layer of longitudinal bundles, somewhat differentiated into two layers in the ventral half of the section, and everywhere traversed by radial cross bundles and connective-tissue septa. Next follows a thick transverse layer, which gradually thins out towards the sides and becomes lost in the dorsal part of the section. The deeper parts of the section are seen to be made up chiefly of longitudinal bundles, freely crossed by thinner transverse and diagonal layers and bundles. Interspaces freely communicating together and with a central larger one are abundant throughout the sections.

November 17, 1881.

Nostoc Zetterstedtii, J. E. Aresch., *from the Malar Lake.*—Dr. E. P. Wright exhibited this curious *Nostoc*, discovered in July 1865, by Zetterstedt in the Malar Lake; it was first described by M. Areschoug in the Algæ Exsiccatæ of Wittrock and Nordstedt, 1872. It is distinguished from all the other species of the genus, writes Bornet, "by its globulous fronds and its warty surface, composed of a number of more or less deeply divided lobes, radiating from a centre to a periphery. With age the frond would seem to become hollow in the middle; its consistency is firm and resisting; its colour black when dry, of an olive-green in fresh-gathered specimens; the cells are subgloboso or oblong, a little contracted at the points; the sheaths are indistinct, and the gelatinous mass appears to be homogeneous in the central portion of the frond; at the periphery the sheaths are visible, and are coloured of a slate-blue by the chloro-iodide of zinc. The heterocysts are somewhat spherical, solitary or in groups of from three to twelve attached in rows. Bornet regards as heterocysts and not as spores those large cells attaining a diameter of 10 to 15 thousands of a millimètre, which form moniliform series intercalated in the trichomes; and of this he thinks he has found the proof in the manner of their behaviour with the chloro-iodide of zinc; for under the influence of this reagent one can distinguish an internal wall which is coloured violet, and an external one remaining uncoloured; and in all the species of *Nostoc* the spores of which he has examined, these are never coloured by this reagent." In the very interior of each mass Dr. Wright found a mass of lichen-like tissue.

Sections of Leaves of Abies Pattoniana.—Dr. M'Nab exhibited sections of the leaves of the specimens named *Abies Pattoniana*, in the museum and herbarium of the Royal Botanic Gardens, Edinburgh. These were Cascade-Mountain specimens (Jeffreys, No. 430), identical with the plant described by Mr. Andrew Murray, in 1855, as *Abies Hookeriana*, and quite distinct from Jeffreys's Mount-Baker plant, sent by him under the manuscript name of *Abies Pattonii.*

Ditrema flavum, Archer, *occurring in Scotland.*—Mr. Archer showed the test of *Ditrema flavum*, which he had met with in Scotland. It is curious that neither the present form nor *Amphitrema Wrightianum* has seemingly been met with out of the United Kingdom, whilst *Diplophrys Archeri*, the other known amphitrematous thalamiphore, has now been encountered in many places; but the two forms in question are certainly to be accounted as amongst the rarities.

Odontophore of Fusus antiquus.—Prof. Mackintosh exhibited the odontophore of *Fusus antiquus*, showing also, for the sake of contrast, that of *Buccinum undatum.*

December 15, 1881.

Apatite in Micaceous Diorite.—Prof. Hull, F.R.S., exhibited a thin section of a micaceous diorite from a dyke half a mile east of Streamstown, near Clifden, Connemara, remarkable for the number and size of the crystals of apatite which it contains. The rock consists of a felspathic crystalline base, in which are enclosed numerous well-formed crystals of hornblende in short prisms, a few flakes of mica, pseudomorphs after olivine, and crystalline grains of magnetite. The association of these minerals causes the section to present a very beautiful and varied aspect under polarized light.

In addition to the above, the rock is traversed in all directions by numerous long slender prisms of apatite, which in some cases show pyramidal terminations, and, when cut transversely by the plane of the section, hexagonal forms. In two or three instances sections are shown nearly perpendicular to the principal axis, and when polarized appear dark with crossed nicols. The determination of these prisms, both as regards form and optical properties, is therefore complete; and it may be supposed that the rock from which the section is taken is very rich in phosphate of lime.

Cosmarium platyisthmum, n. s.—Mr. Archer exhibited a new *Cosmarium* of minute size, but not amongst the most minute, of a quite unique form; in general outline in front or broad view much resembling, say, a section of a double (railway) "rail," or, say, that of a pulley—that is to say, the isthmus very broad and comparatively long (the body of the "pulley"). Thus the "isthmus" makes up a great porportion of the whole *Cosmarium*; the semicells are elliptic, much broader than high (forming the rim or external pro-

jection of the "pulley"), the whole smooth; end view elongated, compressed; extremities rounded. This much for a general description; but it is further necessary to say that the lateral extremities of the semicells somewhat taper ere becoming rounded off, and the upper margins are notably retuse at middle. In the same gathering occurred bodies in pairs, larger, more densely filled with green contents, quadrate, with angles produced in a horizontal manner, and surrounded by a rather dense common mucous investment. In other words, these much resembled the *Cosmarium* just described: that is, they were formed, as it were, of very wide and but shallow "semi-cells" connected by a very broad (notably broader than in the *Cosmarium* described), nearly equally quadrilateral "isthmus." Now this looked very like another "form" of the *Cosmarium*, plumper, stouter, broader, in fact more resembling the zygospore of, say, *Penium didymocarpum*, only of a different colour (that is, of a brilliant) in place of a dull green, and by no means so thick-walled. Indeed, though here likened to that zygospore, they could not be at all mistaken the one for the other. A point of resemblance in common was their occurring in pairs. However, Mr. Archer was not disposed to regard these as truly another *Cosmarium*, or another "form" of the same *Cosmarium*, but in reality the zygospore of the first mentioned, occurring in twins or pairs, and in a general way a good deal resembling, as pointed out, that of *Penium didymocarpum*.

In only one instance, however, in the gathering were the empty parent cells detected; but here they seemed to be attached in a similar manner at the outer angles as they are in the species referred to. But, however curiously these may have resembled in outward configuration the parent, they were not at all identical, the central portion being much broader, the projections at the angles shorter and narrower, the whole aspect more square or more equally quadrate, and the pairs of individuals combined in a hyaline but somewhat dense common mucous matrix. But as in only one instance could the empty parent cells be detected, it is therefore not quite certain that this is truly the zygospore of the former. At all events, the first might stand as *Cosmarium platyisthmum*.

Microphotographs of Bacteria.—Mr. R. J. Moss showed some excellent microphotographs of *Bacteria* and of yeast-plant, from a series he is making with a view to investigate the purity and quality of brewers' yeast.

BIBLIOGRAPHICAL NOTICE.

Den Norske nord-havs-expedition 1876–1878. VIII. *Zoologi, Mollusca.* I. *Buccinidæ*, ved Herman Friele. Med 6 plancher og 1 kart. 4to. Christiania: Gröndahl and Sons, 1882.

This is one of the last admirable volumes which have been pub-

lished by the Norwegian government on the results of the late exploration of the deep sea lying between the western coasts of Norway, Iceland, Jan Mayen, and Spitzbergen. The exploration was made in the 'Voringen,' a steamer of about 400 tons, which had been fitted out for that purpose; and it was conducted by Professor Mohn, whose work and reputation as a physicist, and especially in meteorology, are so well known to the scientific world. His colleagues were the veteran Professor Danielssen, Professor G. O. Sars (a worthy son of a worthy sire), Herr Friele, and other naturalists. This exploration occupied nearly three months in each of the years 1876, 1877, and 1878. The first year's expedition was divided into three cruises, and extended along the western coast of Norway to the Færoe Isles and Iceland. There were twenty-four dredging-stations, at depths of from 90 to 1862 fathoms, besides five shore stations in Norway, Færoe, and Iceland. The second year's expedition was divided into four cruises, and extended from Bergen to outside the Loffoden Isles within the arctic circle, and from Tromsö to Jan Mayen; there were twenty-eight stations, with depths of from 70 to 1760 fathoms, besides six shore stations in Norway and Jan Mayen. The third year's expedition was divided into three cruises, and extended to Vardö beyond the North Cape, and thence eastward to Bear Island, and afterwards to Spitzbergen, in 80° N. lat. The last expedition had thirty-six stations, with depths of from 21 to 1686 fathoms, besides seven shore stations on the arctic coasts of Norway, and in Bear Island and Spitzbergen.

The publications, of which Herr Friele's work, which we will now mention, forms the eighth part, consist of the following memoirs:—1st, Chemistry, by Hercules Tornoe; 2nd, Fishes, by Robert Collett; 3rd, Gephyrea, by Professors Danielssen and Koren (who have been so long associated in their excellent investigation of certain branches of the marine Invertebrata of Norway); 4th, Historical account and apparatus, by the Commander of the expedition, Capt. Wille, of the Norwegian Royal Navy; 5th, Astronomical Observations, Geography, and Natural History, by Professor Mohn, and Magnetical Observations, by Capt. Wille; 6th, Holothurioidea, by Danielssen and Koren; 7th, Annelida, by G. A. Hansen; 8th, the memoir by Friele; and 9th, on the solid matter in sea-water and oceanic deposits, by L. Schmelck. Other memoirs are promised. All of those already published are abundantly illustrated by charts, maps, plates, and in other ways. The letterpress is in Norse and English, showing on the part of our Scandinavian brethren in science a great compliment to the widely spread language of England. The distribution of this great and costly work has been made on the most liberal scale, equal to that of scientific publications by the Government of the United States. It may be favourably contrasted with the parsimonious conduct of our own Treasury in respect of the publications of the 'Challenger' expedition. A copy of the last-mentioned publications ought to have been presented not only to every university and academy in Europe and America, but also to all the accredited authors in those departments of science which are treated of in the publications. Neither

has been done. Such illiberal conduct is unworthy of this empire, and has given considerable dissatisfaction in other c The present deficiencies or fallings off in our national e afford no excuse.

But to resume our notice of the present memoir. Herr F painstaking conchologist of some experience, and is not at to the too prevalent vice of many continental conchologists cating new species, whether from insufficient knowledge c poor and spurious kind of vainglory. A noteworthy in his conscientiousness and true love of science occurs in merging his *Buccinum Morchi* as a variety in the *B. hydr* of Hancock, as well as in his generous remarks on the l other conchologists.

The subject of the present memoir is the family Buccinidæ, w may be said to be especially at home in the arctic and nort seas of both hemispheres. According to the views of the author family comprises the genera *Jumala* with one species, *Volu* with one species, *Pyrolofusus* with one species, *Neptunea* (*Neptunia* seu potius *Neptunina*) with seventeen species, *Tros* with one species, and *Buccinum* with twelve species: in all si genera and thirty-three species. The varieties of other species ar also noticed. Ten species are for the first time described an figured. We must demur to this multiplication of genera, believing that the grounds of distinction are not sufficient, and that all the above-named genera are merely sections of the Lamarckian genus *Fusus* and the restricted genus *Buccinum*. The present author attaches considerable importance to the dentition as a generic character; but this is, at any rate, a difficult basis of classification. What are we to do with the fossil, and consequently now toothless, Gastropods? The structure, and even the presence of the odontophore, in that order of Mollusca depends on the nature of their food. The late Dr. Gray and Prof. Troschel, who were the chief apostles of this doctrine, carried it to a great extreme; and the latter went so far as to distinguish as separate species, on odontological grounds, some (e. g. *Admete crispa* and *A. viridula*) which all other conchologists regard as the same. Herr Friele has conclusively proved that in the Buccinidæ "diversity of dentition affords any thing but a trustworthy guide" in distinguishing species. One important ch racter of such distinction has not been lost sight of by him, viz. th shape of the apex or embryonic whorls.

Although it is generally expected that every review or notice of a work ought to contain some criticism, it would not be easy to find many faults in this memoir. Perhaps, judging from the descriptions and plates, it may be thought that *Neptunea Hanseni* has a suspicious resemblance to *N. turgidula*, and *Buccinum sulcatum* to one of the numerous varieties of that polymorphous species *B. grœnlandicum*, which last may possibly have to be merged in *B. undatum* as an arctic variety. *Neptunea curta* is apparently not the species so named by Dr. Gwyn Jeffreys, but his *Fusus Sabini*=*F. ebur*, Mörch. We think *N. Mohni* should be generically separated as *Mohnia*, on account of its abnormal and Littorinidan operculum. More information as to the geographical and bathymetrical range of most of

the species would also have been acceptable. The photographic figures of the shells are inimitable; but the same unqualified praise cannot be bestowed on the three figures of animals in the first plate. There are copious particulars of the geological stations and a full explanation of the plates. An index nominum would also have been useful. The work is a first-rate contribution to natural history; and the further memoirs of this author will be equally welcome to conchologists.

MISCELLANEOUS.

On the Suctociliata of M. de Mereschkowsky. By M. E. Maupas.

In the 'Comptes Rendus' of the meeting of 11th December (p. 1232) M. de Mereschkowsky has published a note upon an Infusorian, containing conclusions of too great importance to be accepted without their being previously submitted to a severe examination. This examination is the more necessary because the authority of this observer, who is well known by other important memoirs on the Protozoa, may lead to the acceptance as well founded of facts which are far from being correct, or from having the significance that is ascribed to them by the Russian naturalist.

And, in the first place, we find that M. de Mereschkowsky in asserting that no form intermediate between the Ciliata and the Tentaculifera had been previously indicated, seems not to have taken account of the previous works. As long ago as 1867 Stein* made known a new form, baptized by him by the name of *Actinobolus varians*, which, according to his short description, would answer much better to the *desideratum* in question than the type now proposed by M. de Mereschkowsky. But it might be objected to the authors who have been inclined to make this intermediate type of *Actinobolus*, that Stein had given no indication of the mode of action of the tentacles of this Infusorian. This being the case, it is impossible to appreciate their true morphological value, and there is nothing to guarantee that we have to do with organs perfectly homologous with the tentacles of the Acinetans. It is a fundamental objection which we shall oppose afresh to the Infusorian of M. de Mereschkowsky.

This author also affirms that all the Acinetina bear vibratile cilia only during their embryonic state. But every one now-a-days knows very well that certain *Podophryæ* and all the *Sphærophryæ* can at pleasure, during the whole of their existence, resume their ciliary covering, and thus become again as free and vagabond as the most active of the Ciliata. These facts have long been well established by the labours of Stein, Balbiani, Engelmann, and myself. In 1876†, attaching an exaggerated importance to this return to a higher form, I put forward the notion that we might make these types into a separate group under the denomination of *Ciliosuctoria*. Since then more thoroughgoing investigations have led me to quite different ideas.

* 'Der Organismus der Infusionsthiere,' ii. p. 169, note.

† Archives de Zoologie expérimentale, v. p. 425.

Coming now to the new Infusorian proposed as an intermediate form, we shall see that M. de Mereschkowsky is equally ill-informed with respect to it. This type, in fact, is much better known, and has been so for a longer time, than he thinks. It was first discovered in the North Sea, and published by Claparède and Lachmann* under the name of *Hatteria pulex*. Since then it has been met with, first in the marine aquarium of Frankfort by Fresenius†, who gave it the name of *Hatteria tenuicollis*; a second time in the marine aquarium of Breslau by Cohn‡, who baptized it by a third name *Acarella siro*; and, finally, for the third time by Quennerstedt§, upon the coast of Sweden. All these different names belong to a single species more or less imperfectly seen or studied. For my own part I have met with it on the coast of Brittany, at the Zoological Laboratory of Roscoff, and very frequently upon the Algerian coast. Stein ||, without having personally observed it, classes it, I think definitively, in his genus *Mesodinium*. We see therefore that it is a widely distributed type, and has been already much studied by good observers. All these authors, without a single exception, have regarded *Mesodinium pulex* as a Ciliated Infusorian nearly related to the *Hatteriæ*.

The whole of the new theory of M. de Mereschkowsky is founded on the presence of small appendages arranged upon the margin of the orifice of the neck, and which he thinks he has been the first to perceive. But they are already very well figured in the drawings of Claparède and Lachmann, as well as in those of Fresenius, who, moreover, has described them in his text. I have myself observed them many times. The Russian naturalist makes them out to be suckers identical with those of the Acinetina; but I must declare that I have seen nothing in them to make me regard them as such, any more than Claparède, Lachmann, and Fresenius: and it must be admitted that M. de Mereschkowsky has got no further than we have in this respect. Their assimilation to the suckers of the Acinetina is a purely gratuitous assumption on his part, and not founded upon any positive observations. To assert a fact of such importance, and draw from it such important conclusions, he ought to have positively seen these appendages acting as true suckers: this we are not told; and it has evidently not been seen.

I think, moreover, that it was useless to go so far to seek the explanation of the function and significance of these appendages. All observers, including M. de Mereschkowsky himself, have remarked that *Mesodinium pulex* often attached itself to objects by its anterior extremity, and remained thus for a long time motionless. Hence, I am convinced that these appendages have no other function than that of serving as organs of fixation; and the Russian naturalist assures us that he has seen them act as such.

Another consideration, drawn from comparative morphology, may

* Études sur les Infusoires et les Rhizopodes, p. 370, pl. xiii. figs. 10, 11 (1858-60).

† Der Zoologische Garten, 1865, p. 84, figs. 11-13.

‡ Zeitschr. f. wiss. Zool. xvi. p. 293, figs. 32, 34 (1866).

§ Bidrag till Sveriges Infusorie-fauna, iii. p. 32 (1869).

|| Der Organismus &c. ii. p. 162, note 2 (1867).

be opposed to M. de Mereschkowsky's conception. In all known Acinetina which, in the embryonic or adult state, may bear vibratile appendages, these appendages always belong to the category of simple vibratile cilia. The vibratile appendages of *Mesodinium pulex*, on the contrary, are true cirri—that is to say, composite cilia much thicker at the base than at the apical extremity, and consequently corresponding to a stage of development superior to that represented by the vibratile cilia of the Acinetina. This fact, of itself, suffices to dispel all notions of relationship between the latter and *Mesodinium pulex*.

I think I have now sufficiently demonstrated that the new group Suctociliata was founded only upon insufficient observations badly interpreted. I will, however, repeat what I have already stated (with details in its support) in a more extended memoir* :—the ancestral affinities of the Acinetina ought to be sought rather in the direction of the Heliozoa than in that of the Ciliata.—*Comptes Rendus*, December 26, 1882, p. 1381.

On the Molluscan Fauna of the Varangerfjord. By MM. G. Pouchet and J. de Guerne.

During the expedition of the corvette 'Coligny,' last year, some dredgings were made in various parts of the Varangerfjord and in the tributary fjords on its south side. The greatest depth was 445 metres. The Mollusca are represented by more than 1500 specimens, as follows :—

	Genera.	Species.
Lamellibranchiata	24	38
Solenoconcha	2	3
Gasteropoda (exclusive of Nudibranchs)	29	53
	—	—
Total.	55	94

Certain forms, such as *Cardium ciliatum*, *Chrysodomus Turtoni*, &c., regarded by Sars as very rare in these localities, were collected alive. *Astarte sulcata*, *Mactra subtruncata*, *Neæra obesa*, *Panopæa norvegica*, *Dentalium entalis*, and *Rissoa proxima* have to be added to the list of Mollusca of Eastern Finmark given by G. O. Sars in 1878 (Moll. Region. Arct. Norveg.). These species extend southwards into the boreal and celtic regions, and some even into the Mediterranean. All are rare in the Varangerfjord.

The character of the fauna is decidedly arctic. More than a third of the species obtained are circumpolar. Sixty-six are known in glacial deposits. To obtain them living at their maximum of present development, we have to go to higher latitudes. Some are also met with in the cold waters of the great depths of the ocean, or in regions much further south than Finmark, on the east coast of North America (Labrador, Newfoundland, Massachusetts).

Of the ninety-four species, sixty-three are noted from Greenland, fifty-five from Spitzbergen, forty-two from Novaia Zemlia and the Kara Sea, and forty-one from Behring's Straits.

At the surface, the temperatures in which these Mollusca live are

comprised between -2° and $+10^{\circ}$ C. ($=28^{\circ}\cdot4$ and 50° F.); the l. observed in July, is probably about the maximum. In the mid. of the fjord, at a depth of 350 metres and a temperature of $37^{\circ}\cdot4$ F., upon very fine clayey mud, such forms as *Pecten grœnlandicus* and *Siphonodentalium vitreum* were met with.

The Varangerfjord and the neighbouring regions of the glacial sea do not freeze in winter. Whether this is to be explained by the very problematical extension of the Gulf-stream, or by the influence of the great south-east to north-west atmospheric current, the existence of which is now proved, the fact exists that while the condition of its superficial waters seems to unite the Varangerfjord with the Atlantic, the temperature of its bottom-waters, as also its molluscan fauna, approximate it to those seas which are covered with ice during the greater part of the year.—*Comptes Rendus*, December 11, 1882, p. 1231.

Contributions to the Developmental History of the Prosobranchiata. By Dr. Carl Rabl.

This memoir divides into two parts—the first treating of the question of the ultimate fate of the gastrula-mouth in *Paludina vivipara*, while the second relates to some later developmental processes in *Bythinia tentaculata*.

The question of the fate of the gastrula-mouth is of great theoretical importance; and there is at present scarcely a point indevelopmental history about which there has been more dispute, and upon which opinions are more divided. The author finds that in *Paludina vivipara* the gastrula-mouth gradually but completely closes in the median line of the ventral surface; that, further, soon after its closure the anus makes its appearance, but is in no way connected with the gastrula-mouth; and that, lastly, the permanent mouth appears at the spot where the last residue of the gastrula-mouth had closed up. These statements are certainly in contradiction to those of some other authors, but show that a common mode of development may be set up, at least for the Gasteropoda.

The second part treats of the structure of the velum, the origin of the upper œsophageal ganglion, the structure of the primitive kidneys and the intestine, and of the development of the persistent kidneys. The author finds that the velum in *Bythinia* is composed of large cells containing vacuoles, and differs in some other characters from the corresponding organ of other Gasteropod embryos; that the superior œsophageal ganglion originates in the form of a thickening of the outer germ-lamella (vertical plate); that the primitive kidneys are composed of a few, not very large, perforated cells; that the foundation of the persistent kidneys stands in no genetic relation to the ectoderm; and, finally, that in some respects the intestine possesses interesting peculiarities. The author has endeavoured to bring these results into agreement with his previous statements upon the development of *Planorbis*, and to show that the same laws which had proved to prevail in the case of *Planorbis* apply also to *Bythinia*, and that the differences result from the greater abundance of nutritive vitellus which is presented by the germs of the latter.—*Anzeiger Akad. Wiss. Wien*, January 18, 1883, p. 13.

On a new attached Crinoid, Democrinus Parfaiti, *from the Dredgings of the 'Travailleur.'* By M. E. Perrier.

Among the results of dredgings made at great depths none have excited a more lively interest than the discovery in the living state of forms which were believed to have long since disappeared. Among the fossil Invertebrata there are few that, during the Primary and Secondary periods, played so important a part as the attached Crinoids, and are so badly represented in existing nature. When, in 1755, Guettard announced the existence of a living *Pentacrinus* in the West Indies, it was almost a scientific event; for a long time this species remained the only representative of a group which was formerly extraordinarily varied and so rich in individuals that its representatives must sometimes have formed vast submarine prairies. Slowly other types have been added to the list, nearly all found in deep seas; so that the order of the attached Crinoids is now represented by fourteen species. These are as follows:—*Pentacrinus asteria, Mulleri, decorus, Wyville-Thomsoni, Maclearanus, Blakei,* and *alternicirrus, Rhizocrinus lofotensis* and *Rawsonii, Bathycrinus gracilis* and *Aldrichianus, Holopus Rangii, Hyocrinus Bethellianus,* and *Hyponome Sarsii.*

The dredgings of the 'Travailleur' have just revealed the existence of a fifteenth form, brought up from a depth of 1900 metres on the coast of Morocco, off Cape Blanc. We propose to give this new Crinoid the name of *Democrinus Parfaiti**.

Democrinus is distinguished at once from all the other genera by the constitution of its calyx, which is formed of five long basals constituting of themselves a funnel-shaped calyx; a circular groove separates these five basals from five rudimentary radials, which are crescentiform, alternate with the former, and are themselves surmounted by five free, movable, rectangular axillary radials, to which, respectively, are attached five arms, much broader than the radials. These arms break very easily at the level of their articulation with the axillary radials, which then fold down upon the roof of the calyx; of three specimens that we have been able to examine, two are completely destitute of arms, and the third only presents very short remains of them, from which it is easy to see that the arms must have had an extremely small development; but we cannot ascertain whether or not they bore pinnules. In *Rhizocrinus* and *Hyocrinus* the arms are simple, as in *Democrinus*; but in the former the basals are amalgamated and the calyx is partly formed by radials; and in the second the first radials are larger, soldered together, and also take part in the formation of the calyx. Moreover, in the latter the roof of the calyx is covered with calcareous plates. Like the *Rhizocrini,* the *Democrini,* of which the peduncle is destitute of cirri, are attached to the ground by a greatly developed radicular apparatus.

Of all the existing attached Crinoids the *Democrini* are those in

* We dedicate the species to the commander of the 'Travailleur,' M. T. Parfait.

which the transverse dimensions of the calyx are the smallest . tively to the diameter of the peduncle. If we consider that in t. existing free Echinoderms the whole body only represents the calyx of the attached Crinoids surmounted by its arms, we are astonished to see a part which is absolutely *nil* in the representatives of the other groups acquire in *Democrinus* so great a development that it represents at least five or six times the volume of the body properly so called. This fact alone warns us that the peduncle must be regarded as of great importance in the determination of the fundamental form in the Echinodermata. In *Democrinus* it produces a radicular apparatus formed of ramified articulated branches having the same structure as itself, and presenting dimensions superior to those of the arms: this apparatus cannot be neglected from a morphological point of view; and one is led to regard its different branches as having the same value as the peduncle itself, of which they possess the structure.

In one of our *Democrini* the peduncle furnishes two bundles of roots and becomes slightly attenuated in the region where these appendages originate; but it afterwards resumes its primitive dimensions; and we cannot avoid inquiring whether the part which is produced beyond the roots is not destined to become a second peduncle surmounted by a second calyx. If this induction should be verified, the *Democrini* will constitute the first existing example of Echinoderms living in colonies and ramified.

In a former work * I have shown that there exists a striking parallelism between the Echinodermata and the Cœlenterata with a radiate structure. Under the empire of a determinate condition of existence, namely fixation to the ground, the Cœlenterata form arborescent colonies upon which modified polyps group themselves in whorls, just as the leaves of plants do to produce flowers, and thus give origin to radiate organisms, Medusæ or Coralliarian polyps.

The greater number of the primitive Echinodermata were fixed to the ground; the existing Echinodermata are all radiate; it was natural to conclude that the same condition of existence had led, by the same mechanism, to the formation of organisms presenting the same mode of symmetry in the two groups of the Cœlenterata and Echinodermata. But the series of Echinodermata wanted the arborescent forms, which are the starting-point of all subsequent evolution in the Cœlenterata. The *Democrini* evidently serve greatly to diminish this gap. Even if they did not live in colonies, the considerable bulk of their branched roots, the resemblance of these roots to the arms which surmount the calyx and with which they are probably homologous, suffice to demonstrate that the arborescent arrangement of parts, which is in some sort a preface to radial symmetry, is not more foreign to the type of the Echinodermata than to the type of the Cœlenterata.—*Comptes Rendus*, February 12, 1883, p. 450.

* Les Colonies Animales et la formation des Organismes.

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XXXI.—*Further Remarks on the Morphology of the Blastoidea, with Descriptions of a new British Carboniferous Genus and some new Devonian Species from Spain.* By R. ETHERIDGE, Jun., and P. HERBERT CARPENTER, M.A., Assistant Master at Eton College.

1. *Introduction.*

Since the appearance of our previous paper* upon the morphology of the Blastoids, we have been enabled, thanks to the kindness of many friends, to considerably extend our researches in this interesting order of the Pelmatozoa. New material has been sent us by Mr. C. Wachsmuth, of Burlington, Prof. A. G. Wetherby, of Cincinnati, Prof. W. H. Barris, of Davenport, Prof. A. H. Worthen, of Springfield, Illinois, Prof. F. Römer, of Breslau, Profs. A. Gaudry and E. Perrier, of Paris, and Don Lucas Mallada, of the Mining School in Madrid. All these gentlemen have responded to our inquiries with the most liberal kindness, for which we tender them our heartiest thanks.

We have also received some valuable corrections with regard to the stratigraphical position of certain species. Following what we believed to be good authority, we referred the doubtful *Pentremites Römeri*, Shum., to the Chemung

* "On certain Points in the Morphology of the Blastoidea, with Descriptions of some new Genera and Species," Ann. & Mag. Nat. Hist. ser. 5, vol. ix. April 1882, pp. 213–252.

group, or Upper Devonian of Missouri. We are inforn however, by Mr. S. A. Miller, of Cincinnati, that this speci really belongs to the Kinderhook group (Marshall group of Winchell) in the lower portion of the Subcarboniferous series; and also that *Schizoblastus missouriensis*, Shum. sp., which we quoted as Devonian, really belongs either to the Warsaw or to the Kaskaskia group of the Subcarboniferous.

It likewise appears that the existence of the Spanish *Pentremitidea Paillettei* in the Devonian rocks of America must be regarded for the present as extremely uncertain. Mr. Wachsmuth informs us that the specimen in his collection which we referred to this type * was obtained by him from a dealer, who gave its locality as Charleston, Indiana. But none of the local collectors have ever met with a similar one; and it is therefore very far from certain that the species does occur in America, where no other European Blastoids have yet been found. We have been pleased to discover, however, that the Eifel species *Pentremitidea clavata*, Schultze, also occurs in the Devonian rocks of the province of Leon, in Spain, where it appears to exhibit the same variability of form as the Eifel specimens do. So far as we know at present, this species has a wider distribution in Europe than any other Blastoid. Examples of it were kindly sent to us by Don Lucas Mallada, to whom we are also indebted for the opportunity of describing another species of *Pentremitidea* and a very remarkable large *Phænoschisma*, together with the first European species of *Troostocrinus*.

2. *Note on the Ambulacra of* Orophocrinus.

In all the figures of *Orophocrinus stelliformis* which have hitherto been published, the ambulacra are represented as quite narrow and as separated from the hydrospire-clefts by what appear to be actual portions of the radial and oral plates; so that these clefts would not be simply the lateral portions of the radial sinus which are left unfilled by the ambulacra, but actually excavated in the substance of the calyx-plates themselves. They are described as follows by Messrs. Meek and Worthen †:—" So-called ovarian openings, commencing one on each side near the inner ends of the pseudo-ambulacral or arm areas, and extending outward along the margin of a broad sulcus, and near the edges of these areas, for about half the length of the latter, as very narrow slits, widest at the inner end, where they connect with the inner ends of the internal

* *Loc. cit.* p. 223.

† Geological Survey of Illinois, vol. v. p. 466.

pressed tubes under the areas;" and they also add the following footnote (p. 466):—"These slits seem, as it were, to cut off a thin slice from each of the edges of the anal and interradial pieces, as well as from the margins of the deep pseudo-ambulacral sinuses of the radials. These slices are thicker near the upper (inner) ends, where they sometimes become callus, and apparently anchylosed, in adult specimens, to the pore-pieces, so as to give the pseudo-ambulacra the appearance of greater breadth there than is natural." The hydrospire-clefts of *O. gracilis* are described as follows:—"Openings usually called ovarian apertures, in the form of distinct elongated slits, widest at the upper end and extending down apparently three fourths the length of the pseudo-ambulacra, so very close to the margins of the latter as scarcely to leave more than a very thin intervening space above and apparently none below."

From the passages just quoted and from the figures illustrating them, it would thus appear that Messrs. Meek and Worthen considered the apparent separation of the hydrospire-clefts and ambulacra of *O. stelliformis* by portions of the oral and radial plates to be a character of specific value, distinguishing it from *O. gracilis*. Following up this idea, we pointed out last year that *O. gracilis* "bridges over the gap between the American and the European species; for not only are the hydrospire-clefts in the latter much wider than in the former, but they are also contiguous to the ambulacra without the intervention of a part of the radial plate" *.

We have since found, however, that what appear to be portions of the calyx-plates between the hydrospire-clefts and the proximal ends of narrow ambulacra in *O. stelliformis* are really the lateral portions of wide and somewhat petaloid ambulacra. In well-preserved specimens they are crossed by fine lines, continuous with, but less distinct than, those which start from the median groove. The latter separate the inner ends of the large triangular side plates, while the former separate their broader outer ends and are usually entirely obliterated.

The lancet-plate is broad and nearly fills up the radial sinus, *i. e.* the whole space between the hydrospire-clefts. Its sides slope downwards rather steeply from the narrow median groove; and upon them rest the side plates, the section of which at the proximal ends of the ambulacra is nearly an equilateral triangle. The upper side is slightly incurved; and that portion of the curve which is immediately next to the food-groove is all that is usually represented as side plate in

* *Loc. cit.* pp. 250, 251.

figures. In reality, however, the whole surface between food-groove and the cleft is formed by side plates. But the divisions between them are much more marked near the food-groove than they are near the cleft. In fact the broad outer portions of the plates seem to coalesce so completely that they look like portions of the calyx-plates intercalated between the sides of narrow ambulacra and the clefts, as implied in the quotations given above.

But in one specimen we have found that the side plates are readily separable; and then it is apparent that their outer portions really belong to the ambulacra, and are not parts of the calyx-plates. An approach to this condition occurs in the Belgian *O. Orbignyanus*, in which there is a sort of thickened rim to the wide ambulacrum; but it appears to be chiefly formed by the outer side plates, of which, like Meek and Worthen, we have not succeeded in finding any definite trace in *O. stelliformis*.

Somewhat before the middle of the ambulacra the side-plates begin to diminish very rapidly in size, and the hydrospire-clefts consequently approach more closely to the linear median portions of the ambulacra. Their length seems to vary considerably in different individuals; but some little way before the end of the ambulacra the side plates meet the radials and obliterate the clefts altogether.

3. *Remarks upon the Genus* Eleacrinus (*Römer*, 1851).

Nucleocrinus, Conrad, 1842.
Olivanites, Troost MS., 1849.

It appears to us, for reasons which are stated below, that Römer's name is the one by which this type ought to be known. Conrad's description * of it under the name of *Nucleocrinus* runs as follows:—"This genus differs from *Pentremites*, Say, in having only one perforation at top which is central." He gave a figure of his one species, *N. elegans*, though no description accompanied it; and a comparison of this figure with one published later by Hall † shows that the fossil is represented in an inverted position. We infer from this that the "central perforation at top" is really what Hall described as "the concavity at the point of attachment of the column." He says nevertheless that Conrad's figure "sets at rest all question as to the fossil intended." This may very well be the case so far as he is concerned; for he had originally

* Journ. Acad. Nat. Sci. Philad. vol. viii. p. 280, pl. xv. fig. 17.

† Fifteenth Annual Report N. York State Cab. 1862, t. i. figs. 14 and 15.

..ained the specimen on which Conrad based the genus. But he admits himself that its general form, which is all that the figure shows, resembles that of *Pentremites Norwoodi*, which is a *Granatocrinus*, and of *P. melo*, which is a *Schizoblastus*. In fact it was not until the publication of Hall's own observations in 1862 that the nature of *Nucleocrinus* was satisfactorily known. Meanwhile, however, Römer * had given an elaborate description of the *P.* (*Olivanites*) *Verneuili*, Troost, and pointed out that it represented a new generic type, for which he proposed the name of *Eleacrinus*. But although it subsequently appeared that *Eleacrinus Verneuili* and *Nucleocrinus elegans* are congeneric, Hall considered "that there can be no doubt as to the propriety of restoring the earliest name," i. e. *Nucleocrinus*.

We entirely dissent from this proposition, and feel it only right to adopt Römer's name, as has been already done by Shumard † with the following remarks:—"Strictly adhering to the laws which govern naturalists in such cases, we cannot in justice to Römer set aside his name. The description of Conrad was not only extremely imperfect, but it is entirely erroneous and calculated to mislead the student in his efforts to identify the fossil he attempted to describe. In a word, no one could possibly recognize the genus from Conrad's description, since there is no section of the family Blastoidea presenting such a structure."

We have but little information to give respecting the morphology of *Eleacrinus*, and are inclined to accept as correct the analysis of the calyx of *E. Verneuili* as given by Römer with the modification introduced by Hall. Lyon's description ‡ was much more elaborate than Römer's, which he spoke of as defective in many respects; but we have little doubt that in most points the one given by the German palæontologist is the more accurate of the two. Lyon's analysis of the interradii was not accepted by Hall, who followed Römer in considering the four normal ones as formed merely by the large deltoid (oral) plates. On the anal side, however, Hall admits a triple division of the interradius, though not in the manner described by Lyon, but as follows:—"A narrow intercalated plate on the anal side reaches from the aperture to the radial plate dividing the interradial on that side into two narrow curving plates."

* Monographie der Blastoideen (Berlin, 1852), pp. 55–60, Taf. v. fig. 1.

† "Catalogue of the Palæozoic Fossils of North America.—Part 1. Pal. Echinodermata," Trans. St. Louis Acad. 1866, vol. ii. no. 2, p. 368 (note).

‡ Rep. Geol. Surv. Kentucky, vol. iii. p. 487.

We are inclined to believe that this is really the case, as does Montgomery *, the latest writer on the subject; but we must take exception to the manner in which he compares *Eleacrinus* to *Pentremites*. The "situation of the anal orifice" in the former type is in no way peculiar, but perfectly normal; and it has nothing whatever to do with the presence of an extra interradial in the hinder interambulacrum, although this is obviously due to the existence of the anal plate. Mr. Montgomery also says that "in *Pentremites*, in which the lateral opening is completely wanting, there is of course no anal plate." This statement sounds rather strange to any one acquainted with Römer's careful description of the manner in which the large anal spiracle is divided into a median (anal) and two lateral openings.

Eleacrinus, like various other Blastoids, has been described as possessing a dicyclic base. Lyon believed himself to have discovered that below the pieces which Römer described as basals there are three yet smaller ones, separating them from the top stem-joint, and also interradial in position. In accordance with his peculiar system of nomenclature, he transferred the name "basals" to these plates, and called the basals of Römer "primary radials," although they are only three in number and are not situated in the direction of the rays; while the fork-pieces or true radials were called primary radials, second series. Hall made no mention of the plates termed basals by Lyon, though they were redescribed by Billings †, who corrected the errors in Lyon's terminology. Zittel says nothing about them, however; and they are also left without notice by Montgomery. As in the cases of *Pentremites* and *Orophocrinus*, we can only say that we have never seen them, but do not deny their existence and are open to conviction.

We would remark, however, that if the plates of the lower series (supposing them to exist) are interradial, as the upper ones are, they can be in no way homologous with the underbasals of the Crinoids; for these alternate with the basals proper (subradials or parabasals of the old nomenclature), as has been already pointed out by Meek and Worthen ‡. In fact the existence of two successive series of interradial plates between the stem and the radials would be such an anomalous feature in the morphology of the Pelmatozoa, and, in-

* "A Blastoid found in the Devonian Rocks of Ontario," Canadian Naturalist, vol. x. no. 2.

† American Journal of Science, July 1869, p. 229.

‡ Geol. Survey of Illinois, vol. v. p. 464.

..d, of the Echinoderms generally, that we are justified in demanding the most conclusive evidence of it.

Römer's original specimens of *E. Verneuili* having the peristome closed by the summit-plates, he was led to regard the lateral opening as an oro-anus; and although this misconception was set right by Hall and others, it was still advocated by Billings *, with whose peculiar views respecting Crinoid morphology it harmonized most admirably. We think, however, that it may now be regarded as entirely extinct.

These summit-plates are often arranged with a singular regularity, which is much more apparent than is usually the case in other Blastoids. Römer figured seven, one in the centre and six peripheral. These were also mentioned by Lyon, together with fifteen others, the nature of which is by no means clear from his description of them. According to Hall the summit is occupied by five or more plates, while one of our own specimens shows a central one immediately surrounded by seven others, with smaller ones outside them. These summit-plates appear to be larger and less numerous in *Eleacrinus* than they are in *Granatocrinus*, *Schizoblastus*, and *Orophocrinus*; but we are not inclined on that account to attribute to them any special morphological value, as some writers have done.

We are able to confirm Billings's account of the two hydrospires on each side of the ambulacra of *E. Verneuili*, and have also been able to make out the watervascular ring, with radial trunks proceeding from it, just as in the more common Blastoids.

The species of *Eleacrinus* appear to be as follows:—

Pentremites (*Olivanites*) *Verneuili*, Troost MS. Corniferous formation (Devonian), Kentucky, Ohio, &c.

Olivanites angularis, Lyon. Ditto.

Nucleocrinus elegans, Conrad. Hamilton group (Upper Devonian), New York.

N. lucina, Hall. Ditto.

N. Conradi, Hall. Upper Helderberg group (Lower Devonian), New York.

? *Granatocrinus Kirkwoodensis*, Shumard. St.-Louis Limestone (Subcarboniferous), Missouri.

† *Nucleocrinus canadensis*, Montgomery. Hamilton group (Upper Devonian), Ontario, Canada.

* *Loc. cit.*

† It is very doubtful whether this species is really distinct from *E. lucina*. Montgomery strongly suspects it to be so, but does not give a definite opinion.

4. *A new Genus of British Carboniferous Blastoids.*

Genus Acentrotremites, gen. nov.

Gen. char. Calyx large, elliptical, and flattened at the base, generally resembling that of *Granatocrinus* in the form and proportions of its component plates. Spiracles ten in number, and remote from the apex, being placed at the points where the oro-radial sutures meet the somewhat narrow ambulacra. Anus distinct, and situated at the apex of the oro-anal plate. Hydrospires, appendages, and column unknown.

Obs. We have established this genus for a very remarkable type from the Carboniferous Limestone, which resembles *Granatocrinus* in general appearance, and especially those species like *G. Norwoodi* and *G. angulatus*, which have relatively large radials and small orals. But the summit-characters of *Acentrotremites* are entirely different from those of *Granatocrinus*; for it has a distinct anal opening, which pierces one of the oral plates, and ten spiracles as well; while the anus of *Granatocrinus* is confluent with one of the spiracles, and these openings, except in *G. Rofei*, are single and not paired. They are also close to the peristome, and actually pierce the substance of the oral plates. In *Acentrotremites*, on the other hand, the spiracles are some little way from the peristome, so as to be visible in a side view of the calyx. About one fifth of the whole length of the ambulacra lies between them and the radial centre; and they merely notch the lower lateral angles of the oral plates where these join the radials. The result of this must be that the proximal ends of the hydrospiral tubes are situated at a point much lower in the calyx than is generally the case in the Blastoidea.

Acentrotremites perhaps approaches most closely to *Schizoblastus*, and especially to *S. Sayi*, which also has ten spiracles at some little distance from the peristome and a distinct anal aperture. The orals of this species, however, are enormous, though they are much smaller in *S. melo*, *S. neglectus*, and *S. pisum*. The first of these three species has only eight spiracles, the remaining two being confluent with the anus. The independence of the anus in the two latter species is not certain; but in any case, as in *S. Sayi*, the spiracles are formed exclusively by the edges of the oral plates, while in *Acentrotremites* they are partially bounded by the radials.

This type also resembles *Troostocrinus* in the presence of a

tinct anus and of ten spiracles; but these openings are close to the peristome in the latter genus, and bounded by the orals, while the external aspects of the two types are entirely different.

The same may be said of *Orophocrinus*, which likewise has a distinct anus and ten groups of hydrospires. The enlarged proximal ends of the clefts by which these open externally represent the spiracles of *Acentrotremites*; and in the best-known species, *O. stelliformis*, they occupy very much the same position as their homologues do in that genus, viz. at the junction of the oro-radial sutures with the ambulacra. But the other characters of *Orophocrinus*, and more especially those of the European species, are such as to separate it entirely from *Acentrotremites*.

Eleacrinus is yet another type with ten spiracles and a separate anus. But the asymmetry of its calyx and the immense size of its oral plates, which alone form the spiracles, separate it distinctly from *Acentrotremites*. We think, however, that these two genera, together with *Schizoblastus*, form a tolerably well-defined family, which we propose to call Eleacrinidæ. Its leading characters would be, the generally elliptical form of calyx, the presence of ten groups of hydrospires, and in most cases of a corresponding number of spiracles, which merely notch the sides of the oral plates, and the independence of the anal opening from the spiracles except in certain species of *Schizoblastus*.

The national collection at South Kensington contains two specimens of *Acentrotremites*, which have enabled us to study some of the characters of this peculiar type. One of them is from the Carboniferous rocks of Somersetshire, and corresponds in its general appearance with the *Mitra elliptica* of Cumberland*. The other, collected in Derbyshire by the late Mr. Rofe, is merely a fragment, showing portions of three ambulacra; but it is obviously congeneric with the Somersetshire species. The latter is of unusually large size, being 30 millim. high and 25 millim. across the base, and must be considered the type of the genus. It has very much the general form of *Granatocrinus derbiensis* or of *G. campanulatus*, while the Clitheroe species must be more like *G. ellipticus* or *G. elongatus*. There is a curious point of difference between the Somersetshire example and Cumberland's figure of *Mitra elliptica*. The latter shows five basal plates, occupying the larger portion of the flattened base of the calyx;

* Reliquiæ Conservatæ (Bristol, 1826), p. 33, pl. B.

but in the former these are replaced by a circular cavity, wh is filled in with calcspar, the remains of the upper stem-joints. The interradial sutures extend downwards as far as this depression, in which we may fairly expect that basal plates would be found just as in some species of *Granatocrinus*. In *Mitra elliptica*, as figured by Cumberland, the basals form by far the largest portion of the flattened base, while in our specimen this is chiefly formed by the inturned portions of the radials. Under any circumstances Cumberland's figure must be erroneous; for no known Blastoid has more than the normal number of three basals; and bearing this in mind, we have little hesitation in referring our specimen to Cumberland's type.

5. *On the Genus* Astrocrinus, *T. & T. Austin* (*emend. Morris*).

Astrocrinites, T. & T. Austin, Ann. & Mag. Nat. Hist. 1842, vol. x. p. 112; ibid. 1843, vol. xi. p. 205.
Zygocrinus, Bronn, Index Pal. Nomenclator, 1848, p. 1381.
Astrocrinus, Morris, Cat. Brit. Foss. 2nd ed. 1854, p. 72.
Astrocrinites, Etheridge, jun., Quart. Journ. Geol. Soc. vol. xxxii. 1876, p. 103.

Obs. Since the description by one of us, seven years ago, of *Astrocrinus Benniei*, further examples of this remarkable type have come to hand; and the present state of our knowledge of Blastoid morphology enables us to form a better idea of its structure and systematic position than was possible in 1876.

This aberrant member of the Blastoid group is distinguished by the peculiar modification or apparently abortive condition of one of the ambulacra. It was partly this feature which led one of us, in describing *A. Benniei*, to regard its calyx as quadriradiate, although it is really quinqueradiate, as in all Blastoids.

Although *Astrocrinus* has been considered a Cystidean by various palæontologists, we have little doubt that it is a Blastoid and closely allied to the singular genus *Eleutherocrinus* of Shumard and Yandell *. As in that type, there are four normal and linear ambulacra, together with an azygos one of a somewhat different character, which was described by Austin as the anus. In both genera the distal end of this azygos ambulacrum is received in the scarcely perceptible fork of a radial, which is shorter and broader than the other four,

* "Notice of a new fossil Genus belonging to the family Blastoidea, from the Devonian Strata near Louisville, Kentucky," Proc. Acad. Nat. Soc. Philad. vol. xiii. 1856, pp. 73–75, pl. ii.

also causes much of the asymmetry of the calyx. One of the three basals which occur in the calyx of every Blastoid occupies a nearly dorsocentral position; while the two others, which are very closely united, are much elongated and form a projecting fold where they meet the azygosone. They extend upwards onto the lateral portion of the calyx and support the azygos radial, just as the two long basals do in *Eleuthero-crinus*. This radial is thus thrust out of place, modified in shape, and changed in appearance, and lacks the characteristic forked aspect of the radials of Blastoids generally.

The plates on the ventral surface of *Astrocrinus*, formerly described as the "convex crested plates"*, are the orals, which are much larger in this type than in *Eleutherocrinus*; while the "spearhead plates" immediately surrounding the mouth are not additional elements in the calyx, but merely the constricted central ends of the orals. They resemble the corresponding portions of these plates, which have been described as "small rhomboidal pieces" in the summit of *Schizoblastus Sayi*. Just as is the case in *Eleutherocrinus*, the orals on either side of the azygos ambulacrum differ from the other three in outline.

We much regret that the condition of our specimens is very unfavourable to the elucidation of the nature of the hydrospiral apparatus in *Astrocrinus*. That of *Eleutherocrinus* is larger and well developed, as is shown by a specimen in Mr. Wachsmuth's collection; but, judging from the appearance presented by some of the isolated radials of *Astrocrinus*, we think it possible that the hydrospires may have been situated partially or entirely within the substance of these plates, somewhat as they are in *Tricœlocrinus*.

Astrocrinus must have been a free and unattached form; for it does not exhibit the slightest trace of any facet for the attachment of a stem. The same is the case with *Eleutherocrinus*, as pointed out by Shumard and Yandell. This would appear to indicate that the physiological condition presented by *Marsupites* among the Neocrinoids is also reached by some members of the older group of Blastoids. But *Marsupites* has a regular dorsocentral plate, besides basals and underbasals; while *Astrocrinus* and *Eleutherocrinus* seem to have basals and nothing more. Certain species of *Comatulæ* also reach the same condition when mature, the cirri borne by the young centrodorsal plate gradually falling off, while their sockets become entirely obliterated. It is likewise probable that some species of the Palæozoic genus *Agassizocrinus* were free

* Quart. Journ. Geol. Soc. vol. xxxii. pp. 105, 106.

when mature; though the apparent absence of any stem-ta..tà..
in the fossils may be merely the result of weathering, and not due to natural obliteration during life, as in the *Comatulæ* just mentioned.

According to the Messrs. Austin there is in *A. tetragonus* an oval eminence near the centre of the azygos basal, "apparently analogous to the madreporiform tubercle" of the Echinozoa. There is certainly nothing like a madreporite in the Scotch species *A. Benniei*; and we imagine the structure in question to be nothing but the fold which has been already described as marking the union of the azygos basal with the two longer ones.

In the former description of *A. Benniei* by one of us, reference was made to a small spine, which, although not exhibiting any traces of definite attachment to the specimen to which it adhered, was believed to belong to *A. Benniei.* A closer examination of the ornamenting tubercles has led us to the conclusion that some of the larger ones, at any rate, were perforate. This fact has also been independently observed by our friend, Mr. P. Highley, whilst engaged in figuring the specimens; and in our forthcoming monograph illustrations will be given exhibiting this feature. It is not unnatural to suppose, therefore, that some probability exists of the spine previously referred to belonging to *A. Benniei.*

While appearing to agree with *Eleutherocrinus* in general structure, so far as this can be made out, *Astrocrinus* presents several points of difference from that type. It is much smaller and altogether dissimilar in appearance, being flattened and more or less distinctly stellate or lobate. The outline varies considerably, the anterior lobe (*i. e.* that opposite the azygos ambulacrum) being sometimes considerably produced and sometimes comparatively short. The four normal ambulacra cross one another nearly at right angles. This is very far from being the case in *Eleutherocrinus*, where they only occupy 180° of the summit, as is well shown in Shumard's figure; so that the odd ambulacrum takes up a relatively larger portion of the summit than in *Astrocrinus*. The latter genus is limited to the British Carboniferous Limestone, while the two American species of *Eleutherocrinus* are both from the Hamilton group (Upper Devonian). The two genera are so entirely different from all other Blastoids that they must be placed in a family by themselves; and in naming this it is only right to use the term Astrocrinidæ, T. & T. Austin, 1843. Another genus (*Aporocrinites*, Austin, MS.) was also included in this family by its founders; but it has never been described,

as the fossils on which the name was based are not known, no further notice need be taken of it.

The description of *Astrocrinus*, given by the Messrs. Austin, was considered by Pictet * to indicate a complete analogy with *Codaster*, but for the difference in the numbers of the ambulacra. Pictet seems, however, to have entirely forgotten the hydrospires of *Codaster*, though they had been described and well figured by Römer. The only possible resemblance between the two types is that the summit of *Astrocrinus* is slightly truncated. But, apart from the nature of the hydrospires, *Codaster* is symmetrical and has an anal opening, which is absent in the markedly asymmetrical *Astrocrinus*. Even with *Eleacrinus*, which departs a little from the ordinary symmetry of the regular Blastoids, *Astrocrinus* has nothing in common. In the former genus the modification is due to the intercalation of an anal plate, all the ambulacra being alike; and this is very far from being the case in the Astrocrinidæ.

Two species of *Astrocrinus* have been described—*A. tetragonus*, T. & T. Austin, and *A. Benniei*, Etheridge, jun.; but it is quite an open question whether they are not identical. The brief description given of the former is useless for purposes of comparison; but examples of it are very rare, and so badly preserved that its true characters must still remain uncertain. There is but one in the national collection, and a very few others in the museums at Cambridge and York. On the other hand, *A. Benniei* is tolerably abundant in certain localities; and its characters are fairly well defined. It marks a well-known horizon in the Lower Limestone group of the Carboniferous series in East and Central Scotland, where it was discovered some years ago by Mr. James Bennie. The doubtful species, *A. tetragonus*, occurs in the Carboniferous Limestone of Yorkshire, and is said to have been first obtained at Settle.

6. *On the Genus* Stephanocrinus, *Conrad*, 1842.

Stephanocrinus, Conrad, Journ. Acad. Nat. Sci. Philad. 1842, vol. viii. p. 278; Römer, Wiegmann's Archiv, 1850, Jahrg. xvi. pp. 365–375, Taf. v.; Hall, Palæontology of New York, 1851, vol. ii. p. 212.

Obs. In Römer's admirable account of *Stephanocrinus angulatus* the radials are rightly described as fork-shaped, with the two contiguous limbs of adjacent forks produced upwards into strong interradial processes; and the manner in

* Traité de Paléontologie, vol. iv. p. 295.

which this type might be derived from such a form as *Troch. crinus lineatus* or *T. Reinwardti* is clearly pointed out. Hall's description of this singular fossil, written at about the same time as Römer's, was, however, far more complicated. He regarded the radials as comparatively small, and the upward processes as formed by hypothetical "scapular plates;" though most of his figures show the interradial suture along the middle of each process. He admitted indeed that the "scapular plates" might be double; but he seems never to have regarded them as actually part of the radials. The supposed sutures between the costal and scapular plates are probably only the surface markings which are found in so many Blastoids (*Granatocrinus elongatus*, *Codaster pyramidatus*, *Orophocrinus Orbignyanus*, *Phænoschisma Archiaci*, &c.) extending downwards from the radial lip to the upper angles of the subjacent basals. After becoming acquainted with Römer's memoir, Hall seems to have tacitly adopted his views respecting the structure of the calyx; for a small diagram of *S. gemmiformis*, Hall, which he has since published*, differs *in toto* from those which appeared in the 'Palæontology of New York,' and shows the fork-shaped radials more in their proper aspect.

S. angulatus is, in fact, a Blastoid with an unusually deep radial sinus, owing to the excessive development of the radial limbs. The sides of the sinus are much steeper than in *Phænoschisma*, and are not marked by hydrospire-slits; but the ambulacra are quite short and nearly horizontal, as they are in *Codaster acutus* and *Phænoschisma Archiaci*, instead of bending downwards as they do in other species of both these genera. Their distal ends are received in a rather strongly marked radial lip, which was thus described by Hall:—"The upper margins of the costal plates are excavated in the middle, and on their inner margin support a small semicircular plate." Römer described this structure as a reniform scar for the attachment of an appendage—an explanation which seems unlikely, now that Hall has discovered ambulacral appendages in *Stephanocrinus* like those of other Blastoids. We think ourselves that the part in question is nothing more than an infolded radial lip, which is rather more strongly developed than usual, and is much more distinct in some specimens than in others. Something

* See the 28th Rep. N. Y. St. Mus. Nat. Hist. *Mus. edit.* p. 146, pl. xiv. figs. 15, 20 (1879). The *documentary edition* of this report, which contains the plates but no text, appeared in 1876. Both text and plates have been reproduced in the 11th annual report of the 'State Geologist of Indiana,' 1882.

.e same kind appears in the two Belgian species of *Oropho-*
.inus.

The lateral "ovarian opening" of Hall and Römer has been described as the anus by Zittel*, and, we think, rightly so. Sutures appear to us to proceed from it down the steep walls of the radial sinuses at its sides, towards the ends of the short ambulacra. These sutures thus divide the "coronal process" into an outer portion formed by the limbs of adjacent radials, and an inner portion formed by an oral plate. The anal opening is between this oral and the two radial limbs against the inner faces of which it rests; so that it is not confined to an oral plate, as it is in so many Blastoids (*Granatocrinus*, *Pentremites*, &c.), but occupies its primitive embryonic position between two radials and the corresponding oral.

Each of the other spiniform processes in the four remaining interradii is similarly divided into an outer part, formed by the contiguous limbs of two adjacent radials, and an inner portion or oral. The calyx of *Stephanocrinus* thus appears to us to consist of three rows of plates—(1) basals, (2) radials, and (3) orals, just like that of other Blastoids. Römer† thought that he was able to detect the oro-radial sutures, but hesitated to express a decided opinion about them; and Hall seems to have thought their presence possible in *S. angulatus*. In his *later* figures of *S. gemmiformis* he actually represents a "third range of plates," which are obviously small orals; and he speaks of them in *S. pulchellus*‡ as "extremely minute, except on the anal (?) side, where the terminal plate broadly truncates the upper sides of the two adjacent plates of the second range;" but his figure is too small to show this properly, as is also that of Messrs. Miller and Dyer§. The *Stephanocrinus osgoodensis* of the first of these authors ‖ is still too imperfectly known for an opinion to be formed on this point.

The ambulacra of *Stephanocrinus* are even now but little understood. According to both Hall and Römer the summit of *S. angulatus* consists of a central "proboscis" of five plates, from which five pairs of linear plates extend along the ambulacra. We have only seen this proboscis in one specimen, but regard it as a vault of a few plates covering in the

* Paläontologie, Bd. i. p. 436.
† *Loc. cit.* p. 370.
‡ Indiana Report, p. 280.
§ Journ. Cincinn. Soc. Nat. Hist. vol. i. pl. ii. fig. 13.
‖ Ibid. vol. ii. pl. x. fig. 7.

peristome, like those already referred to in *Eleacrinus*. paired linear plates in the ambulacra we believe to be sir and to represent the lancet plates of other Blastoids. Th seem to be usually much eroded and to have a strongly marked median groove, which has been taken for a suture. Even when these plates are preserved the side plates of the ambulacra are generally missing; but since Hall has discovered specimens of *S. angulatus* still retaining ambulacral appendages like those of other Blastoids, we see no reason to doubt the existence of side plates and outer side plates. In fact, the former have been described in *S. pulchellus* by Miller and Dyer. This species, together with *S. gemmiformis* and *S. osgoodensis*, is much more like other Blastoids than the better-known *S. angulatus*, which has a very peculiar external form, owing to the great development of the interradial processes.

The most striking fact, however, in the morphology of *Stephanocrinus* is the apparent absence of hydrospires. Each radial sinus is closed below by downward extensions of the plates at its sides; and even when the lancet plates are removed there is absolutely no trace of any hydrospires, such as are so visible on the more or less sloping sides of the radial sinuses in *Phænoschisma* and *Codaster*. But we know that *Stephanocrinus* had ambulacral appendages like those of other Blastoids; and we believe these to have had a ciliated ventral surface along which currents of water flowed down into the hydrospires through the marginal pores of the ambulacra. The appendages of *Stephanocrinus* were doubtless of the same nature as those of other Blastoids; and it is to be expected that hydrospires were also present, though they may have been, and probably were, actually within the substance of the radials as in the distal portions of the ambulacra of *P. conoideus* and throughout the greater part of their length in *Tricœlocrinus* and perhaps in *Astrocrinus*.

The absence of any external indication of hydrospires is a very marked feature of *Stephanocrinus*; and it is therefore with no little surprise that we have found Prof. Hall writing even as late as 1879, and again last year*:—*S. gemmiformis*. "The structure of the calyx and the arrangement of parts on the summit and ambulacra appear to be identical with *Codaster*. . . . . In the structure of the body at least there are no differences which appear to be of generic importance between *Stephanocrinus* and *Codaster*." As a matter of fact, however, these two genera are as widely different as any two of the symmetrical Blastoids can well be. In all members of the group the structure of the "body" is

* Indiana Report, pp. 270, 280.

Pa cal, basals, radials, and orals entering into its composi-tion in varying proportions. But while the ventral surface or "summit" of *Codaster* is marked by eight groups of hydro-spire-slits, with from five to twelve slits in each group, that of *Stephanocrinus* is absolutely free from any thing of the kind. In *Orophocrinus* and in *Phænoschisma* the hydrospire-slits are more or less visible externally, as they are in *Codaster*.

In *Pentremites*, *Pentremitidea*, *Troostocrinus*, *Granatocrinus*, *Schizoblastus*, and other genera they may be exposed by re-moving the lancet plates from the ambulacra. But in *Stephano-crinus*, as perhaps also in *Tricœlocrinus*, even this extreme measure fails to reveal their presence, and their nature must remain uncertain until specimens are found in a sufficiently good state of preservation for sections to be made of them. *S. pulchellus* was first described as a *Codaster* by Miller and Dyer; and Hall transferred it to *Stephanocrinus* with a ?. But his statements respecting the identity of the two genera are utterly incomprehensible to us. Neither his description of *Stephanocrinus* nor that of Miller and Dyer contains any mention of the hydrospiral apparatus which has been described in *Codaster* by M'Coy, Römer, Rofe, Shumard, Lyon, and also by Prof. Hall himself!

The same remarks apply to the *Codaster pentalobus* of Hall* from the Niagara group of Waldron, Indiana. It appears to us to be the upper portion of the calyx of a *Pentremitidea*, broken across at the basiradial suture. The *Codaster grati-osus* of Miller† is also a very doubtful representative of the genus. The only known specimen is an exceedingly perfect cast from the Keokuk group (Carboniferous) of Missouri. It is said to have no orals; but there are "ten marginal supports of the interambulacral areas, one being placed upon each side of the ambulacral spaces." What these may be we will not venture to say; but we are surprised to find no mention of any casts of the hydrospires, and are therefore sceptical about the *Codaster*-nature of the specimen.

The following are the known species of *Stephanocrinus*:—

Stephanocrinus angulatus, Conrad. Niagara group (Upper Silurian), New York.

S. gemmiformis, Hall. Ditto.

Codaster pulchellus, Miller & Dyer. Niagara group, Indiana.

Stephanocrinus osgoodensis, Miller. Ditto.

* Indiana Report, pp. 280, 281, pl. xv. fig. 16.

† Journ. Cincinn. Soc. Nat. Hist. vol. ii. Jan. 1880, pl. xv. fig. 5.

7. *On the Genus* Tricœlocrinus, *Meek and Worthen.*

Obs. The name *Tricœlocrinus* was suggested by Messrs. Meek and Worthen * as that of a proposed subgenus of *Troostocrinus*, Shum. We have already mentioned that we believe Shumard's genus to be a good one, and have pointed out some other characters which we regard as distinctive of the type †. Messrs. Meek and Worthen, accepting the genus provisionally, described a new species under the name of *Pentremites* (*Troostocrinus?*) *Woodmani* ‡; but they pointed out at the same time that it presents some rather strongly marked differences from the typical *Troostocrinus*; for "the body is broadest below, while the base is comparatively very short and wide, and has the three spaces corresponding to the flattened sides of the typical species of *Troostocrinus* so very profoundly and broadly excavated as to impart a very remarkable appearance to the lower part of the fossil." The figures of *P. Woodmani* represent a type which is so very different from *Troostocrinus* as understood by Shumard and by ourselves that we have no hesitation in accepting *Tricœlocrinus* as a valid genus. We are somewhat surprised, however, to find *P. varsouviensis* referred to this type by Meek and Worthen §; for it is described as being closely allied to *P. lineatus*, which is an undoubted *Troostocrinus*, and the figures given of it show no trace of an excavated base.

On the other hand, the form figured by Meek and Worthen as *Tric. obliquatus* ‖ is a true *Tricœlocrinus*, though we have considerable doubt as to its identity with the species which was described under that name by Römer ¶ from some isolated radial plates. There are some similar plates in the national collection, which we have examined; while we have also obtained a section of a *T. Woodmani* in Mr. Wachsmuth's collection. These have shown us that throughout the greater part, if not the whole length, of the ambulacra the hydrospiral tubes do not project downwards into the visceral cavity. The radials are very thick and incompletely excavated by their median sinuses; so that the enlarged lower ends of the hydrospiral tubes actually rest on a floor which is formed by the body of the radial, an internal view of one of these plates not having the forked appearance of its outer surface.

* Illinois Report, vol. v. p. 508.

† *Loc. cit.* pp. 247–249.

‡ *Loc. cit.* pp. 508, 509, pl. xvi. fig. 4.

§ Illinois Report, vol. vi. p. 521, pl. xxxi. figs. 8 and 9.

‖ *Ibid.* pl. xxxi. fig. 4.

¶ *Loc. cit.* p. 47 (367), Taf. iii. fig. 11.

Practically, therefore, the hydrospires are situated actually within the substance of the radials. We have already pointed out that this condition occurs at the distal ends of the ambulacra of *P. conoideus* *, and that we suspect its presence in *Stephanocrinus*, at any rate in *S. angulatus*, and in *Astrocrinus*.

We think that, apart from the other characters mentioned by Meek and Worthen, this peculiarity affords an excellent distinction between *Tricœlocrinus* and *Troostocrinus*; for we have found the hydrospires of *Troostocrinus Reinwardti* and *T. lineatus* to be perfectly normal in character, like those of the typical Pentremitidæ. Unfortunately we know next to nothing about the spiracles of *Tricœlocrinus*. Meek and Worthen describe those of *T. Woodmani* as small and very closely approximated; but they say nothing about those of *T. obliquatus*. From various specimens that we have seen (all, however, more or less incomplete) we are inclined to think that the spiracles of this genus are essentially similar to those of *Troostocrinus*.

The following are the species comprised in the genus as we understand it:—

†*Pentremites obliquatus*, Römer. Carboniferous Limestone, Indiana.

P. (*Troostocrinus?*) *Woodmani*, Meek and Worthen. Keokuk group? (Lower Carboniferous), Indiana.

P. (*Tricœlocrinus*) *obliquatus*, Meek and Worthen. St.-Louis group (Lower Carboniferous), Illinois.

8. *Descriptions of three new Species from the Lower Devonian of Spain.*

Genus Pentremitidea, D'Orb. 1849 (emend. E. & C. 1882).

Pentremitidea Malladæ, sp. nov.

Sp. char. Calyx pentagono-pyramidal, expanding gradually upwards, with the greatest periphery at about one third of its length from the summit. Section pentagonal, with wide and shallow re-entering angles between the ambulacra. Summit

* *Loc. cit.* p. 210.

† According to Römer (p. 72) there is some resemblance between the linear ambulacra of this type and those of the cast described by Shumard as *P. laterniformis*. Hambach says, however, and apparently with good reason, that the latter is merely an internal cast of *P. sulcatus* (Trans. St. Louis Acad. Sci. vol. iv. p. 147, pl. B. fig. 10).

truncated and relatively large. Basals forming a st... broad and deep cup. Radials quadrangular, with projecting lips, the body slanting sharply downwards, and the limbs, which are rather longer than it, curving upwards towards the summit, thus increasing its apparent breadth. Radial sinuses long, narrow, and curved downwards, with a general angle of 111° to the plane of the summit. Ambulacra narrow, of nearly uniform width throughout. Lancet plates small, scarcely occupying the entire width of the sinuses. Side plates about fifteen in number, large and strong, projecting above the margins of the sinuses and somewhat petaloid in shape. Orals not apparent in a side view, though relatively large and triangular, each with a strongly marked median ridge separating the spiracles at its sides. Surface of the calyx ornamented by strong and coarse concentric lines. Diameter of summit 7·5 millim.

Obs. The outline of the calyx readily distinguishes this species from the three found in the Eifel by Schultze. It is pyramidal from the base to the radial lips, while the latter are clavate and obpyriform. Its pentagonal section will prevent its being confounded with the decagonal *P. angulata*, nob., which has the interradial sutures raised, and not depressed as in *P. Malladæ*. The latter has larger orals than *P. similis*, nob., while its calycular outline is totally different. The longer, narrower, and more curved ambulacra and shorter base separate it from *P. lusitanica*, nob.; while, on the other hand, it has not the broadly truncated summit and narrow elongated base of *P. Paillettei* and *P. Schultzei*.

When describing *P. similis*, we noted the resemblance in the general form of its calyx to that of *Orophocrinus*. *P. Malladæ*, on the other hand, exhibits a digression towards *Codaster*; for the pyramidal outline of the calyx is not at all unlike that presented by *C. Hindei*, nob.

We have connected the name of this species with that of Don Lucas Mallada, to whom we are indebted for the opportunity of describing both it and the two following species. The material which he kindly sent us contained a single specimen of what appears to be yet another species of *Pentremitidea*, though it is too imperfectly preserved for us to venture on any description of it. According to Römer *, Verneuil's collection contains two other species of Blastoids from Asturias, one of them resembling *Orophocrinus inflatus* in external form. Unfortunately, however, they have never been described, and we can therefore do nothing more than note their

* *Op. cit.* p. 55 (375).

Rence. Blastoids also seem to occur in the Lower Devonian of France; for the *Belocrinus Cottaldi*, Mun.-Chalm., of which Œhlert has recently given a good figure *, appears to us to be nothing but the elongated basal cup of a *Troostocrinus* or *Pentremitidea*. It appears to be different from that of any Crinoid.

Locality and Horizon. Colle, near Sabero, Province of Leon, Spain; Lower Devonian.

Genus Troostocrinus, Shumard, 1865.

Troostocrinus hispanicus, sp. nov.

Spec. char. Calyx subfusiform and elongated, but less so towards the base than in some other species of the genus. Basal cup conical, with shallow re-entering angles in its upper edge, while its sides become compressed and flattened below. Radials long and narrow, twice the length of the basals, and about equally divided into body and limbs; the interradial sutures comparatively straight and almost parallel. Radial sinuses narrow and sublinear. Ambulacra slanting sharply down from the summit and gradually decreasing in width, with the side plates projecting above the margins of the sinuses, and at least twenty-five in number on each side; the median food-grooves very well defined. Orals exceedingly minute and quite apical. Spiracles, peristome, and ornamentation not preserved. Total height of calyx 25 millim.

Obs. Although the specimen just described is but imperfectly preserved, it is one of unusual interest, as it affords the first satisfactory indication of the presence of *Troostocrinus* in European rocks. *T. hispanicus* is a much more robust species than *T. Reinwardti*, the type of the genus, having larger, wider, and more expanding ambulacra than occur in that well-known form. The summit is also more spacious and more truncated than the corresponding part of *T. Reinwardti*. The Spanish fossil may be distinguished from *T. bipyramidalis*, Hall sp., by its shorter ambulacra and fewer side plates, together with the greater elongation of the calyx from the radial lips downwards. The proportions of *T. subtruncatus*, Hall sp., and of *T. Grosvenori*, Shumard, are quite different from those of *T. hispanicus*. Perhaps on the whole the latter agrees better with *T. Wortheni*, Hall sp., than with any of the species just named, except that its ambulacra are broader. They are relatively longer than those

* "Crinoïdes nouveaux du Dévonien de le Sarthe et de la Mayenne," Bull. Soc. Géol. de France, 3e série, t. x. p. 362, pl. ix. fig. 3.

of *T. subcylindricus*, Hall sp., and the radial angles are very different in the two forms, while the long radials of *T. lineatus*, Shum., and the appearance of its orals in a side view of the calyx are sufficient to distinguish it from *T. hispanicus*.

Locality and Horizon. Colle, near Sabero, Spain; Lower Devonian.

Genus PHÆNOSCHISMA, E. and C. 1882.

Phænoschisma nobile, sp. nov.

Spec. char. Calyx elongately pyramidal, with the summit flattened, and strong interradial processes which terminate but little above the level of the peristome. Radials arched, very long and narrow, the body and limbs being about equal in length. The radial sinuses between them are deep and exceedingly wide, with high sloping sides, the edges of which are prominent and a little thickened. The oral plates are large and form the summits of the interradial processes, one of which is truncated by the triangular-pyriform anal opening. Ambulacra linear, of uniform width throughout. Lancet plates occupying their entire width, and completely covered by the side plates, which are more than twenty-five in number and somewhat wedge-shaped. Outer side plates very small, placed at the extreme edge of the ambulacra, and standing almost vertically so as to fill in the notches between the outer ends of the side plates. Hydrospire-slits more than thirty in number and closely crowded together, so as to give a corrugated appearance to the sides of the sinuses. Diameter of summit 25 millim. Height of another specimen 36 millim.

Obs. This large and remarkable form is intermediate in character between *Ph. Verneuili*, nob., and *Ph. acutum*, Phill. sp., both of which, however, are of much smaller size. It resembles the first in the form of its plates and ambulacra and in the arrangement of its hydrospire-slits, but differs in possessing a truncated summit; for the median ridges of the oral plates do not slope downwards towards the peristome, as in *Ph. Verneuili*. In this character, however, *Ph. nobile* resembles *Ph. acutum*, though readily distinguished from it by the form of its radial sinuses and ambulacra. It also differs from the other species of the genus in the unusual abundance of its hydrospires, and in the more excentric position of the anal opening.

Locality and Horizon. Colle, near Sabero, Spain; Lower Devonian.

XXXII.—*Description of a new Species of* Perameles *from New Britain.* By Dr. A. GÜNTHER.

THE British Museum has recently received from the Godeffroy Museum a single specimen in spirit of a *Perameles* from New Britain, which appears to be undescribed, and for which I propose the name of *Perameles myoides.* It is an adult female.

Size of a rat. The upper parts and sides are densely covered with two kinds of hairs; the principal kind consists of flat, grooved, spine-like hairs of moderate length, and is intermixed with coarse ordinary hairs of a brownish-red colour. The spines on the back are black, those on the sides blackish, with brownish-red tips. Towards the abdomen the spines are greyish, with whitish tips, the lower parts being covered with soft white hair. The cheeks to the ears are greyish.

Tail very short, not quite so long as the head, naked (or, rather, with sparse minute short hairs), grey. Snout comparatively short, half as long as the head; extremity of the snout naked. Ears naked, of moderate size. Eyes small. Feet short, with claws of moderate size.

	in.	lin.
Length of the body and head	8	3
,, ,, tail	2	1
,, ,, head	2	5
,, ,, projecting part of snout	0	3
Distance from end of snout to the eye	1	2
,, ,, ,, ear	2	0
Length of eye	0	2
,, ear	0	9
Width of ear	0	7
Length of fore foot	0	11
,, hind foot	1	9

XXXIII.—*On* Thuiaria zelandica, *Gray.* By J. J. QUELCH, B.Sc. (Lond.), Assistant, Zoological Department, British Museum.

THE species *Thuiaria zelandica* was described by Dr. Gray in Dieffenbach's 'Travels in New Zealand,' published in 1843; and the type specimens, with the name attached in his own handwriting, are in the British-Museum collection.

At the end of his description he states that this species differs from *Th. articulata* in the form of the cells, and he notifies the absence of vesicles (gonothecæ) from his specimens.

While examining the literature on the Thuiariidæ, I was struck with the resemblance which *Th. dolichocarpa*, Allman (as figured in the 'Journal of the Linnean Society,' vol. xii.), bore to the specimens of *Th. zelandica* in its regularly plumose habit with pinnately disposed *opposite* ramuli, a character that is rare in the genus. Through this I was led to a careful examination of Dr. Gray's species, with this result, that *Th. dolichocarpa* is found to be identical with *Th. zelandica*; and therefore the name *dolichocarpa*, established by Prof. Allman, must give place to *zelandica*, established by Dr. Gray more than thirty years previously.

The description as given by Dr. Gray is utterly inadequate; and it is only legitimate to state that it would have been impossible to identify the species by it. The reason for this, however, as it seems to me, is not far to seek. When the New-Zealand species was described, the genus *Thuiaria* had been but very recently established by Fleming for the reception of the two British species, *Th. thuja* and *Th. articulata*; and Dr. Gray had only to give a very brief description in order to distinguish it from the latter; so that, but for the re-examination of the type specimens, *Th. zelandica* would have remained unrecognized, though its occurrence in the New-Zealand fauna has been in reality twice recorded since by different writers.

For the identification of this species, instead of the description by Dr. Gray, that by Prof. Allman must be taken—a description so complete that it would be easy to identify the species with certainty, even if the figure which accompanies it had not been given.

The type specimens, which are apparently young ones, are eight in number, and range from 40 to 90 millim. in height. They were obtained by Dr. Sinclair, R.N., from New Zealand (the exact locality is not stated), and were presented by him to the British Museum in December 1842.

The single specimen described by Prof. Allman under the name *Th. dolichocarpa* was contained in Mr. Busk's collection, and was obtained from the Northern Island, New Zealand, by Dr. Andrew Sinclair—presumably the person referred to above.

The only other record, that I know, of the occurrence of *Th. zelandica* is that of Mr. D'Arcy W. Thompson, in the Ann. & Mag. Nat. Hist. (5) vol. iii. p. 110. The single specimen there referred to *Th. dolichocarpa*, Allman, was ob-

tained by Dr. Jolliffe at Hokianga, Northern Island, New Zealand, in 1851.

Although there are no gonothecæ on any of the type specimens of *Th. zelandica*, there cannot be any doubt that the description given by Allman applies to this species; for the other characters on which the identification is based are both numerous and definite. A slight exception may, however, be made with reference to the marginal teeth of the hydrothecæ—an exception also noticed by Mr. Thompson in his specimen. These are not uniformly conspicuous. On parts of the pinnæ they are as distinct and as regular as those in Allman's figure; in others they are more or less unequal; while, again, the margin must often be described as being only irregularly dentate, irrespective of the number and size of the teeth. The edge of the mesial keel on the sides of the pinnæ is not always entire, but in parts becomes slightly and irregularly notched, and often divided into two or more raised lines, which are continued on the basal part of the hydrotheca. This condition is more marked on the distal portion of the main stem, where the keel is represented by widely notched raised lines.

Special mention of these minor points has been made with reference to another specimen in the collection, which, though I was at first inclined to describe it as a new species, I think must be regarded as a well-marked variety of *Th. zelandica*. No locality is recorded for the specimen; and gonothecæ are absent; so that it is possible that when this additional information is forthcoming this variety may have to be raised to specific rank. For the present I designate it as *Th. zelandica*, var. *valida*.

Thuiaria zelandica, var. *valida*.

The specimen of this variety consists of a group of more than thirty simple stems arising from a mass of closely interlaced fibres. Its chief difference from the type specimens of the species is its decidedly robust growth. The stems range from 100 to 250 millim. in height; the paired pinnæ, from about 30 to 60 millim. in length, are placed at intervals of from 4 to 5 millim. as compared with pinnæ of about from 10 to 20 millim. at intervals of from 1½ to 3 millim. in the type. Its hydrothecæ are nearly half as large again as those of the type; the lateral notches separating them from the hydrocaulus at their upper portion are not so clearly marked; the marginal teeth are generally wider, more rounded and irregular; the mesial keel at the sides of the pinnæ is less prominent and more frequently represented by the raised notched lines continued to the basal part of the hydrotheca—a condition more markedon the distal portion of the main *stem* than on the *pinnæ* of the type of the species.

XXXIV.—*The Coral-fauna of Ceylon, with Descriptions of new Species.* By STUART O. RIDLEY, M.A., F.L.S.

THE distribution of the Anthozoa and Hydroid Corals in the Indian Ocean is very imperfectly known; those of Ceylon have been almost wholly neglected. Blyth and Kelaart, who have devoted special attention to the animals of Ceylon, do not deal with the corals. Among the few specific references in modern times to the subject, which I have been able to find, is the identification of a stray species from there in Milne-Edwards and Haime's 'Histoire Naturelle des Coralliaires.' Pallas and Esper, who have probably done more for the zoology of the Indian Ocean than any others of the older writers, and of whom the latter exhibits a special acquaintance with Southern India and Ceylon, give the localities of their Indian-Ocean species of corals, for the most part, as "Indian Ocean" or "East-Indian seas;" I have found no specific allusion to Ceylon in connexion with corals in the writings of these authors. Verrill mentions three species with certainty, one with doubt, from Ceylon (Proc. Essex Institute, vols. v. & vi.). Mr. H. J. Carter describes (Ann. & Mag. Nat. Hist. (5) v. pp. 442, 454, vi. p. 152) from the Gulf of Manaar, on the north of the island, under the name *Hydradendrium*, a species obtained by Capt. Cawne Warren with Sponges, Foraminifera, &c., also a species which he assigns to *Tubipora*, also a *Rhizoxenia* and *Spongodes* without specific names.

General remarks on the coral-reefs and corals are found in Prof. E. Häckel's letters to the 'Deutsche Rundschau' for 1882 (translated in part in 'Nature,' 1882), and in a separate work by the same author, entitled 'Indische Reise-Briefe' (Berlin, 8vo, 1883). Prof. Häckel, as is well known, made large collections in Ceylon; and a scientific account of his investigations there is to be anticipated with much interest. Dr. W. C. Ondaatje, F.L.S., Colonial Surgeon of Ceylon, has called my attention to some plates representing Ceylon corals, contained in a work entitled "Ceylon: Skizzen seiner Bewohner, seines Thier- und Pflanzenlebens, by Baron von Ransonnet-Villez," which describes the reefs and enumerates ten species, probably all included in the list below, except two *Turbinariæ*. Darwin describes the reefs generally in his 'Coral Islands.' Sir Emerson Tennent makes a few allusions to corals in his work on Ceylon.

It is to Dr. Ondaatje that we owe this opportunity of becoming acquainted with the precise characters of the Ceylon coral-fauna. His permanent sojourn and his journeys in the island have afforded him special facilities for accumulating facts and

material for the study of this subject; and his interesting collections show how well his energies have been directed. He has liberally presented examples of many of the species below enumerated to the British Museum, and has written an important note on the reefs, which is printed below.

All the specimens collected by Dr. Ondaatje were obtained on the southern coast, in the neighbourhood of Galle, except where otherwise stated; and they were obtained from the shore or from shallow water, with the exception of the Antipatharia, and the *Echinogorgia* and *Menacella*, which were obtained by fishermen in their nets at depths said to amount to from 100 to 150 fathoms.

Although, as might have been expected, the coral-fauna of Ceylon has the same general aspect as that of the other parts of the Indian Ocean so far as it is known, and of the Red Sea, having most of its known species in common with these regions, yet it has peculiarities of its own—viz. one peculiar (so far as is known at present) species of *Cœloria* and a species of *Pavonia*, and one of *Alcyonium*; in the latter two cases the nearest known allies seem to be found in the Pacific. These species are described for the first time in this paper. A *Stephanoseris* described by Verrill is also not known except from Ceylon, so far as I am aware. To sum up, in all we have forty-eight or forty-nine species of corals known to occur in Ceylon, of which four are at present not recorded from elsewhere.

The following is a list of all species which I know to have been obtained at Ceylon; those not obtained by Dr. Ondaatje are marked with a *.

Subclass ZOANTHARIA.

Order **ALCYONARIA.**

Family **Alcyoniidæ.**

Alcyonium polydactylum, Ehrenberg, var. *mamillifera*, Klunzinger.

Alcyonium polydactylum, Ehrenberg, Cor. Roth. Meer. p. 58; Klunzinger, Korallenthiere Roth. Meer. p. 26, pl. i. fig. 6, *b*.

Also found in the Red Sea (*Klunzinger*).

Alcyonium submurale, n. sp.

Upper surface horizontal, level, with the exception of low ridges, which rise between the centre and the edge, gradually increasing in height towards the latter, but not attaining an altitude of more than an inch or two. Ridges about 6 millim.

thick at free edge. Margin of zooid-bearing lamina plicate; surface of this region even, zooids crowded. Pedicel (in medium-sized specimen) almost as broad as the zooid-bearing plate. Colour, in dry state, dark reddish brown, that of sterile pedicel paler. Spicules:—(1) Large double-heads, consisting of a usually extremely short narrower smooth cylindrical median portion, and of two large strongly tuberculated ends, each bearing four or five large broad tubercles covered with minute, sharp-pointed, secondary tubercles; length of spicule ·25, diameter of heads ·18 millim., of smooth median portion ·1 millim. (2) Slender, tuberculate, subclavate, straight, one end tapering to point, the other usually rather blunt and more strongly tuberculate than the former; spicule beset with low tubercles covered with small secondary tubercles; most of the tubercles are arranged into four or five more or less distinct whorls, which surround the spicule and are separated by spaces usually free from tubercles, the remainder are scattered near the ends; spicule about ·25 to ·35 millim. long by ·07 millim. thick. A few stout few-whorled forms also occur in the cortex, perhaps representing intermediate stages between nos. 1 and 2. No. 1 forms the lower side of the frond and the greater part, at any rate, of the stem; no. 2 forms the surface of the zooid-bearing plate, and extends some way beneath it. The entire specimen, of which I have seen a photograph, measured about 8 inches in diameter across the disk.

This in its external form is quite unlike the species *A. pachycladus*, described so fully by Klunzinger from the Red Sea; but the large double-headed spicules ally it to that form. *A. murale* of Dana, of which only the external form is known, seems to differ mainly in the great height of the radiating ridges which there, as here, crown the disk; here, however, they are quite small, even in large specimens.

Sarcophytum pauciflorum, Ehrenberg.

Lobularia pauciflora, Ehrenberg, Corallenthiere Roth. Meeres, p. 58.

Appears to be common on the Galle coast; found in Red Sea (*Ehrenberg*).

Spongodes, sp.

Spongodes, Carter, *l. c.*

Rhizoxenia, sp.

Rhizoxenia, Carter, *l. c.*

Family **Primnoidæ.**

Menacella reticularis, Gray, var.

I have already added a few details of the characters of this

species in this Journal (ser. 5, vol. ix. p. 191). In the specimen brought by Dr. Ondaatje, and presented by him to the national collection, the largest spicules are rather longer and less thick than those described by me (*l. c.*) from the type specimens, and do not exhibit the dark axial coloration which I have mentioned. The Ceylon specimen is the largest which I have seen, and attains the remarkable dimensions of—height 970 millim. (39 inches), greatest diameter 500 millim. (20 inches).

Echinogorgia pseudosasappo, Kölliker.

Gorgonia sasappo, var. *reticulata*, Esper, Pflanzenthiere, ii. p. 48, pl. ix.A.

Echinogorgia pseudosasappo, Kölliker, Icones Histiologicæ, p. 136, pl. xviii. fig. 10.

"East-Indian seas" (*Esper*).

Family **Euniceidæ.**

Plexaura flabellum, Esper.

Antipathes flabellum, Esper, *l. c.* ii. p. 100, pl. i.

Esper's figure represents the axis of what appears to be this *Plexaura*; the localities given by him are the East Indies, and especially the Moluccas. Several specimens were obtained by Dr. Ondaatje.

Family **Gorgonellidæ.**

**Juncella juncea*, Pallas.

Gorgonia juncea, Pallas, Elenchus Zoophytorum, p. 180.

Obtained by Mr. Holdsworth (*coll. Mus. Brit.*).

Subfamily *Sclerogorgiaceæ.*

Suberogorgia verriculata, Esper.

Gorgonia verriculata, Esper, *l. c.* ii. p. 124, pl. xxxv.

**Suberogorgia suberosa*, Pallas.

Gorgonia suberosa, Pallas, Elench. Zooph. p. 191.

A common Indian-Ocean species; it extends to the north of Australia. A specimen is in the British Museum, presented by E. W. H. Holdsworth, Esq.

Family **Coralliidæ.**

Corallium nobile, Pallas.

Isis nobilis, Pallas, Elenchus Zoophytorum, p. 223.

Dr. Lankester ('Uses of Animals to Man'), besides the Per-

sian Gulf, gives Ceylon as a locality for this, the precious Red Coral of the Mediterranean and Cape-Verd Islands; and Dr. Ondaatje has shown me decorticated specimens from Ceylon which make the identity of the species probable. It is noteworthy that a fossil form is recorded from Indian deposits (*Duncan*) which (as I have given reasons for thinking, see Proc. Zool. Soc. 1882, p. 232) seems probably identical with this species, Seguenza having found it fossil in Italy, still bearing a slight red tint.

"An Officer," in a work entitled "Ceylon" (London, 8vo, 1876, 2 vols.), ii. p. 274, mentions small fragments of red coral similar to that of the Mediterranean as having been found at the water's edge between Galle and Colombo, and states it to have been referred to by the Portuguese.

The specimens shown me by Dr. Ondaatje, one of which has been placed by him in the British Museum, have a decidedly *scarlet* colour, which penetrates to the centre; the texture of the corallum is dense; the longitudinal striæ are placed rather further apart in the smaller branches than is usual in the Mediterranean red coral, with which, however, the general habit seems to agree. An examination of the cortex appears to me necessary to the absolute determination of the species.

Incertæ sedis.

**Tubipora reptans*, Carter.

Tubipora reptans, Carter, Ann. & Mag. Nat. Hist. (5) v. p. 442, pl. xviii. fig. 2.

Resembles *Callipodium* in its manner of growth. Only known from a small specimen.

Obtained in Gulf of Manaar (*Carter*).

Order **ZOANTHARIA**.

Suborder Madreporaria.

Family **Astræidæ**.

Galaxea musicalis, Linné.

Madrepora musicalis, Linné, Systema Naturæ, (12) p. 1278.

It is recorded from the Indian Ocean by Milne-Edwards and Haime.

Galaxea Bougainvillei, Milne-Edwards & Haime.

Sarcinula Bougainvillei, Milne-Edwards & Haime, Annales des Sciences Naturelles, (3) x. p. 312.

Mussa ringens, Milne-Edwards & Haime.

Lobophyllia ringens, Milne-Edwards & Haime, Ann. Sci. Nat. (3) xi. p. 247.

Prionastræa seychellensis, Milne-Edwards & Haime.

Prionastræa seychellensis, M.-Edw. & H. Hist. Nat. Cor. ii. p. 517.

Also from Seychelles and Red Sea (*Milne-Edwards & Haime*); north-east of New Guinea (*Studer*).

Prionastræa magnifica, De Blainville.

Favastræa magnifica, De Blainville, Dict. Sciences Naturelles, lx. p. 340.

Also from Batavia, Java (*Milne-Edwards & Haime*).

Prionastræa profundicella, Milne-Edwards & Haime.

Prionastræa profundicella, M.-Edw. & H. Ann. Sci. Nat. (3) xii. p. 131.

Also from New Ireland (*Studer*).

Prionastræa gibbosa, Klunzinger.

Prionastræa gibbosa, Kl., Kor. Roth. Meer. p. 40, pl. iv. fig. 10.

Found also in the Red Sea (*Klunzinger*).

Prionastræa halicora, Ehrenberg.

Astræa halicora, Ehrenberg, Cor. Roth. Meer. p. 97.

Also from the Red Sea (*Ehrenberg*).

Manicina Blainvillei?, M.-Edwards & Haime.

Manicina Blainvillei, M.-Edw. & H. Hist. Nat. Cor. ii. p. 400.

A large explanate specimen; the gyri differ from the description given by the describers in being only 5–8 millim. across, instead of 8–10, and in the depth descending sharply into the calyx. The primary septum bears a paliform lobe in most cases; else I should have referred the species to *Mæandrina*, with which it agrees in other respects.

Cœloria Bottai, Milne-Edwards & Haime.

Cœloria bottæ, Milne-Edwards & Haime, Ann. Sci. Nat. (3) xi. p. 295.

Klunzinger (Kor. Roth. Meeres, iii. p. 17) unites this

species with several others under the name *arabica*; but prefer, on the present occasion, to keep the original name, as it applies to what seems to be a more or less distinct form.

It occurs also in the Red Sea (*Milne-Edwards & Haime*).

Cœloria ascensionis, Ridley, var. *indica*, nov.

Platygyra ascensionis, Ridley, Ann. & Mag. Nat. Hist. (5) viii. p. 438.

Calicles rapidly defined and seldom elongated; extreme diameter 2 to 4 millim.; a paliform, upwardly directed, thickened and roughened process rises in many calicles from the primary septum at the point at which it unites with the columella. This specimen is curiously variable as to the presence or absence of the paliform process referred to; a considerable variation in the size of the calicles appears due to the presence of perforating worm-tubes, causing condensation in parts. The typical form of the species, from which this variety differs in the points above noticed, was described from Ascension Island originally. Colony rising from a somewhat spreading base to form a hemispherical head about 50 millim. (2 inches) in diameter.

Cœloria ceylonica, n. sp.

Colony subhemispherical, massive. Calicles usually distinctly defined, occasionally forming short gyri, curved or undulating, 10 to 11 millim. in maximum length; the fully defined calicle polygonal, about 5 millim. in diameter; depth of calicles from summit of wall to surface of columella about 2·5 to 3·0 millim. Corallum dense and weighty.

Two cycles of septa; a rudimentary third not unfrequently occurring as a ridge about ·5 millim. high and projecting from the wall into the calicle, commencing near the free margin of the wall; primary and secondary septa subequal, their margins sloping down obliquely from summit of wall about 1 millim., and then falling perpendicularly down towards the columella, the primaries reaching and uniting fully with the latter, the secondaries stopping short of its upper part, but uniting with it below. Septa thin; the primaries and secondaries with few very fine granulations on their surface, and with two or three blunt teeth on the lower part of their margin. Wall thin, barely ·5 millim. thick at level of columella, sharp above and serrate with the septo-costal ridges. Columella distinct, formed of few contort laminæ connecting the septa.

The colonies are chiefly small, not exceeding 100 millim. (4 inches) broad and 75 millim. (3 inches) high.

The species differs from the widely distributed Indian-Ocean species *C. Esperi* in the small, more angular calicles, less prominent septa, and the thinner wall. In these points it approaches *C.* (*Platygyra*) *ascensionis*, mihi, from the island of Ascension and of the present collection; but the wall is thinner and the calicles wider than is usual in that form, in which the difference in width between the primary and secondary septa is very marked and the septa are much more closely approximated to each other.

Baryastræa —— ?

A subglobose colony of very dense texture; the calicles small, viz. 2·5 millim. in diameter. The walls are not thick, and exhibit no trace of grooves separating the calicles on their free margins.

Echinopora hirsutissima, Milne-Edwards & Haime.

Echinopora hirsutissima, M.-Edw. & H. Ann. Sci. Nat. (3) xii. p. 187.

Given by the above authors as from the Indian Ocean and as perhaps only varietally distinct from *E. horrida* of Dana, from the Pacific.

Family **Fungiidæ.**

Fungia repanda, Dana.

Fungia repanda, Dana, Zooph. U.S. Exploring Expedition, p. 295, pl. xix. figs. 1–3.

Occurs in Fiji Islands (*Dana*).

Family **Eupsammiidæ.**

Dendrophyllia Ehrenbergiana, Milne-Edwards & Haime.

Cœnopsammia Ehrenbergiana, M.-Edw. & H. Ann. Sci. Nat. (3) x. p. 109, pl. i. fig. 12.

The late Dr. Brüggemann, who records it from the island of Rodriguez (Phil. Trans. clxviii. p. 574), referred the species to *Dendrophyllia*.

It occurs also at the Seychelles and in the Red Sea (*Milne-Edwards & Haime*), and at Mauritius (*Möbius*). Dr. Ondaatje informs me that it occurs occasionally on the reef on the Galle coast. The specimen which I have seen is quite normal, and shows the variability in the development of the columella to which Klunzinger (*l. c.*) has drawn attention.

Family Poritidæ.

Porites echinulata, Klunzinger.

Porites echinulata, Klunzinger, Kor. Roth. Meer. ii. i. p. 43.

Also from Red Sea (*Klunzinger*).

Porites punctata, Linné.

Madrepora punctata, Linné, Syst. Nat. (12) p. 1277.

Porites Gaimardi, Milne-Edwards & Haime.

Porites Gaimardi, Milne-Edwards & Haime, Ann. Sci. Nat. (3) xvi. p. 28.

Also from Fiji Islands, New Ireland, Australia (*Milne-Edwards & Haime*).

Pavonia percarinata, n. sp.

Growth partially incrusting. From an extensive base arise numerous subcylindrical lobes; lobes, when young, 4–5, when old 10–12 millim. in diameter at base, which is almost cylindrical, and on which the carinæ are very slightly marked, becoming irregular in outline towards apex, chiefly owing to the great development in number and size of the carinæ, which attain here a height of 1–2 millim. and are very sharp; they are chiefly longitudinal in direction; ends of lobes more or less rounded off, occasionally showing signs of division into secondary lobes; greatest height 30 millim. Surface of base more even than that of lobes, owing to the inferior frequency and prominence of the carinæ. Calices small, 1·5–2·0 millim. in extreme diameter, depressed; columella a single pointed papilla, often absent or obscure. Septa in three cycles, primaries and secondaries subequal, with strongly convex edge, thin; marginal teeth short, few; denticulations of surface numerous, prominent, sharp; tertiaries sloping obliquely downwards, scarcely half so wide at base as the secondaries; septa sloping more or less downwards from between calices. Corallum dense and massive.

Hab. Galle, Ceylon (*Dr. Ondaatje*).

The species which most closely resembles this externally is *P. prismatica*, Brüggemann (Journ. Mus. Godeffroy, xiv. p. 207), from Bonham Island (Marshall Islands); its lobes have not, however, the triangular form of those of that species; the calices seem to be much smaller, and are neither arranged in distinct transverse rows nor quite horizontal between the calices. *P. repens*, Brüggemann, is also nearly allied, but

wants the very sharp superior carinæ and the strong tendency to form lobose projections.

Pavonia explanulata, Lamarck.

Agaricia explanulata, Lamarck, Hist. Anim. s. Vert. (2) ii. p. 383.

Lamarck gives the species as probably from the Indian Ocean.

Pavonia, sp.

A species strongly resembling *P. repens*, Brüggemann, but with the different cycles of septa quite distinct in size from each other.

Family **Madreporidæ.**

Madrepora cytherea, Dana.

Madrepora cytherea, Dana, Zooph. U.S. Expl. Exp. p. 441, pl. xxxii. figs. 3 *a*, 3 *b*.

A large tabular specimen, rather elevated in the centre. Anastomosis of the branches has gone so far as to leave very few meshes between them; and their ends are but imperfectly distinct. Klunzinger records it from the Red Sea, Dana from Tahiti, Möbius from Mauritius.

Madrepora flabelliformis, Milne-Edwards & Haime.

Madrepora flabelliformis, M.-Edw. & H. Hist. Nat. des Coralliaires, iii. p. 156.

Recorded from the Indian Ocean by the above-named authors.

**Montipora foliosa*, Milne-Edwards & Haime.

Montipora foliosa, Verrill, Proc. Essex Institute, vi. p. 51.

Recorded with doubt from Ceylon by Verrill.

**Stephanoseris sulcata*, Verrill.

Stephanoseris sulcata, Verrill, Proc. Essex Institute, v. p. 48.

Originally described from Ceylon by Verrill.

Group *Tabulata.*

Pocillopora grandis, Dana.

Pocillopora grandis, Dana, Zooph. U.S. Expl. Expedition, p. 533, pl. li. fig. 2.

This species is also found at the island of Rodriguez (*Brüggemann*), and at the Fiji Islands and Tahiti (*Dana*).

Pocillopora brevicornis, Lamarck.

Pocillopora brevicornis, Lamarck, Hist. Anim. s. Vert. (2) ii. p. 443.

Appears to be common at Ceylon. It is also found at the Sandwich Islands and Fiji Islands according to Milne-Edwards and Haime, who also record it from Ceylon; Verrill also records it from Ceylon.

**Pocillopora elongata*, Dana.

Pocillopora elongata, Verrill, Proc. Essex Institute, vi. p. 59.

Recorded by Verrill from Ceylon.

Suborder ANTIPATHARIA.

Cirrhipathes spiralis, Pallas.

Antipathes spiralis, Pallas, Elench. Zooph. p. 217.

This is a common Indian-Ocean species. Pallas's description is extremely accurate and renders identification easy. This is not the species so named by Pourtales (Bull. Mus. Comp. Zool. Cambridge, Massachusetts, vi. p. 114) from the West Indies; it probably does not occur in the Atlantic region.

Cirrhipathes anguina, Dana.

Antipathes anguina, Dana, Zooph. U.S. Expl. Exp. p. 576, pl. lvi. fig. 1.

A species quite distinct from the above, differing in the only slightly twisted condition of the axis and in the arrangement of the spines of the surface: these are longitudinally arranged in *A. spiralis*, with minute ones placed between the larger sharp ones; in *A. anguina* there is an obscure spiral arrangement and the smaller spines are wanting. Also from Red Sea (*Klunzinger*), Fiji Islands (*Dana*).

**Hydradendrium spinosum*, Carter.

Hydradendrium spinosum, Carter, Ann. & Mag. Nat. Hist. (5) v. p. 454, pl. xix. fig. 8.

This was described by Mr. Carter as allied to the Hydroid genus *Hydractinia*; it appears, however, to belong to the Antipatharia, a view to which Mr. Carter himself seems inclined in a paper written subsequently to the original one (*op. cit.* vi. p. 301), mentioning *Antipathes ulex*, Ellis, as apparently identical in form with *Hydradendrium*.

Obtained in 65 fathoms in the Gulf of Manaar (*Carter*).

Possibly identical with the following.

Antipathes fœniculacea?, Esper.

Antipathes fœniculacea, Esper, Pflanzenthiere, ii. p. 152, pl. vii. (? Pallas, Elench. Zooph. p. 207).

Esper's species came from the East Indies; Pallas gives the Mediterranean as the locality; so it is doubtful whether he refers to the same species or not.

Class HYDROZOA.

Subclass HYDROCORALLINÆ (Moseley).

Millepora dichotoma, Klunzinger.

Millepora dichotoma, Klunzinger, Kor. Roth. Meer. iii. p. 86.

Seems to differ from the description of *M. Forskali*, Milne-Edwards & Haime, in having the branches in a large specimen subparallel and almost wholly fused into laminar vertical expansions. Gastropores at very short intervals, viz. 1–2 millim.; dactylopores scattered irregularly between them. In a younger specimen the ends of some of the branches are cuneiform and the branches themselves are more distinct than in the older specimen. I think it best to refer the specimens to the above species, so fully described by Klunzinger, from the Red Sea, and assigned by him with doubt to the same form as the *M. Forskali* of Milne-Edwards and Haime, although the texture of the centre of the branches is denser than that described by Klunzinger, the branches are not particularly brittle, and the distinction in size between the dactylopores and gastropores is well marked.

Note by W. C. Ondaatje, F.L.S., *Colonial Surgeon of Ceylon.*

I may state roughly the chief features of the coral-reefs from which the corals were collected.

The position of the reefs is south-west of Ceylon, fringing the coast of Galle; they are wholly submerged at high tide.

The corals grow in shallow water, and were collected during ebb-tide in the latter end of 1881, a few months previous to my departure for England. The mean temperature of Galle is 79°·9 F.

The predominating kinds which go to the formation of the reefs are as follows:—The family Madreporidæ abounds,

especially the branched species, one species (the *Madrepora cytherea*) forming large slabs. Of the family Poritidæ we have *Porites*; the numerous family of Astræidæ is chiefly represented by the beautiful *Galaxea*, *Manicina*, *Cœloria*, and *Mæandrina*, which is much used in making lime; immense blocks are taken to Colombo by boats for the purpose. Of the Milleporidæ we have one foliaceous species growing in masses. Of the family of Favositidæ one species of *Pocillopora* (*grandis*) grows luxuriantly, forming extensive blocks. One block which I removed from the growing mass two men carried with difficulty. Among the Alcyonoids there are several species of sponge-like appearance under water (*Alcyonium* and *Sarcophytum*), and remarkable for the beauty of their spicules. Among the reefs are to be found Sponges, Polyzoa incrusting the bottom of many corals, Holothurians, &c., *Melobesia* growing in masses with the corals.

My time having been limited, I have not been able to make a thorough examination of the reefs.

XXXV.—*On the Jurassic Varieties of* Thurammina papillata, *Brady**. By Dr. Rudolf Hausler.

[Plate VIII.]

Among the Jurassic Lituolidæ no species deserves our attention in such a degree as *Thurammina papillata*, Brady, on account of its wide range and especially its great variability. There is no positive evidence of the occurrence of the genus *Thurammina* in the Lias and the Lower Dogger, although small fragments of a similarly formed arenaceous type have been occasionally met with. The oldest known perfect specimens of *Thuramminæ* were discovered in the so-called Spathkalke of the Upper Bathonian zone of *Rhynchonella varians*;

* Brady. "Notes on some of the Reticularian Rhizopoda of the 'Challenger' Expedition," Micr. Journ. vol. xix. n. s. p. 26, tab. v. figs. 4–8.
Carpenter. 'The Microscope and its Revelations,' fifth ed. p. 533, fig. 273, *g*, *h*.
Uhlig. "Ueber einige oberjurassische Foraminiferen mit agglutinirender Schale," Neues Jahrb. f. Min. Jahrg. 1882, B. i. p. 152.
Hausler. "Die Astrorhiziden und Lituoliden der *Bimammatus*-Zone," Neues Jahrb. f. Min. 1883, Bd. i. p. 60, Taf. iv. figs. 9–13.
Hausler. "Notes on some Upper Jurassic Astrorhizidæ and Lituolidæ," Quart. Journ. Geol. Soc. vol. xxxix. p. 27, pl. iii. figs. 2–6.

'ey belong to two species, *Th. papillata*, Brady, and *Th. hemisphærica*, Häusl. Both make their appearance again in the compact limestones of the Callovian zones, where, however, they are very rare. The finest and most numerous shells of *Th. papillata* have been collected in the sponge-beds of the Lower Malm, especially in the zone of *Ammonites transversarius* (Argovian I.), where the whole family Lituolidæ reaches its maximum development in the Jurassic formation. In a paper on the *Trochamminæ* of this zone * I proposed to divide the alternating layers of soft marls and harder marly limestones into three subdivisions in the Canton Aargau. In accordance with the different lithological and palæontological characters, we observe certain striking differences in the distribution and the composition of the arenaceous Foraminifera †. The oldest calcareous beds, full of siliceous sponges, Brachiopoda, Cephalopoda, &c., contain a rich fauna of arenaceous types, among which the *Thuramminæ* are conspicuous by their comparatively large size and certain peculiarities in the disposition and shape of the papillæ and the texture of their thin walls. While these beds yielded the largest and most irregular forms of a characteristic yellowish colour, the younger layers contain particularly the more regular colourless varieties, and the youngest argillaceous beds, C, the minute more or less spherical specimens.

These small varieties, somewhat resembling *Th. albicans*, Brady, are unfortunately so cemented into the matrix that it is almost impossible to extract perfect specimens. In the younger zone of *Terebratula impressa* (Argovian II.) the whole genus is represented by a similar very scarce variety of *Th. papillata*. In the compact limestones of the following zones, especially in the sponge-beds of the Lower Sequanian stage, the *Thuramminæ* are moderately plentiful. Towards the Kimmeridge group of the Swiss Jura they disappear gradually; and, so far as I could observe, only one doubtful variety passes into the Lower Cretaceous beds (Neocomian I.) of the Cantons Vaud and Neuchatel.

Further researches in other Jurassic countries will no doubt enable us to give in a short time a more complete account of the distribution of this interesting species.

As a rule, *Thurammina papillata* is found in greatest number and finest specimens in the beds with abundant *Hyperamminæ* (*H. vagans*, Brady).

In comparing a great number of specimens of different ages

* Ann. & Mag. Nat. Hist. ser. 5, vol. x. p. 40.

† These differences and the characteristic varieties will be described in my Monograph of the Foraminifera of the zone of *Am. transversarius*.

and localities, we find that the species can be divided into a number of groups, each of which contains some characteristic, and often remarkably constant, varieties. But, owing to their great variability, most of them can be connected through intermediate forms, forming thus a single series from the simple spheroidal to the most complicated types.

As regards bathymetrical range, the Jurassic *Thurammina papillata* is found in greatest number in the deposits with true deep-sea character, much more rarely and in less typical specimens in those formed at moderate depths. As the distribution of the recent *T. papillata* is world-wide*, its oldest fossil representatives seem to be present in the deep-sea sediments all over Europe in countless modifications, many of which have not been found in a recent state. On the other hand the globular large varieties with small papillæ and very finely arenaceous tests of our existing seas are not known in a fossil condition.

The tests of all the Jurassic specimens of *T. papillata* are very thin, composed of small grains of quartz-sand, neatly fitted together, and united by a colourless, brownish, or yellow cement.

In describing briefly the various groups, I hope to add to the knowledge of the *Thuramminæ*, as well as to that of the Foraminifera in general, in connexion with the great variability of certain forms and the wide geological range of species characteristic of the deeper parts of the present sea.

1. Test free, small (0·1 millim.), more or less spheroidal. Papillæ disposed regularly or irregularly all over the surface. Test finely arenaceous, generally colourless, or of a light brownish colour. A single specimen from the *Bimammatus*-beds of the Portuguese Jurassic formation showed a very dark brown colour. These forms sometimes resemble *Thurammina albicans*, Brady, with which they are found associated in the Upper Jurassic zones, especially in the sponge-beds of the Argovian and Sequanian stage, all over the continent.

Figs. 1–4 represent the more characteristic varieties, and fig. 25 a larger specimen with numerous papillæ. A typical specimen from the *Bimammatus*-beds of Baden (Cant. Aargau) is figured in N. Jahrb. f. Min. 1883, Bd. i. tab. iv. fig. 10.

2. Test free, compressed, generally symmetrical, large (0·5–1 millim.). Papillæ numerous, disposed all over the surface. Colour yellow. The finest specimens from the sponge-beds of the Lower Malm (zone of *Ammonites transversarius*) are almost transparent and of a characteristic yellowish colour (fig. 21).

* Brady, *l. c.* p. 27.

whi·Test free, more or less cylindrical, large. Papillæ numerous, regularly disposed all over the surface in straight lines. Test generally very thin, cement brownish or colourless (figs. 17, 31). These forms seem to be characteristic of the sponge-beds of the Lower Malm.

4. Test free, compressed, often lenticular. Papillæ irregularly disposed, generally near the margins. Some of these varieties resemble *T. compressa*, Brady*; but the texture is the same as in the typical *T. papillata*. Not common in the sponge-beds of the Lower Malm (figs. 11, 18, 22, 26).

5. Test free, more or less spheroidal or cylindrical. Papillæ small, tubular, few in number, placed at one or both ends of the shell. Cement brownish or colourless. Some of the most interesting modifications are represented by figs. 10, 12, 13, 14.

These rare forms were obtained from the marly limestones of the *Transversarius*-zone.

6. Test free, irregular, cylindrical, or flask-like, bearing a single aperture at the end of the chamber. Cement generally colourless (figs. 6, 7). Fig. 8 represents a specimen with two small orifices. A nearly globular specimen from the zone of *Ammonites transversarius*, bearing a long wide cylindrical neck, is figured Q. J. G. S. vol. xxxix. tab. iii. fig. 3, and another from the zone of *A. bimammatus* in N. Jahrb. f. Min. vol. i. 1883, tab. iv. fig. 11.

7. Test free, large (1 millim.), irregular. Papillæ large, conical, touching each other at the base. Cement of a peculiar light yellow or brass-like colour. These varieties appear to be characteristic of the Lower Malm. Figs. 15, 16, 20 represent the simpler forms. A typical specimen is figured Q. J. G. S. vol. xxxix. tab. iii. fig. 2.

8. Besides the above-mentioned forms, the various Jurassic zones from the Bathonian to the Upper Sequanian beds contain numerous quite irregular, sometimes monstrous specimens, as figs. 23, 24, 32, 33.

9. Test fixed, flask-like, without papillæ, ending in a long neck, bearing the large circular aperture. Cement generally hyaline; attached to the shells of mollusks, stems of crinoids, grains of sand, &c. (fig. 9, and N. Jahrb. f. Min. 1883, vol. i. tab. iv. fig. 9), in the Upper Jurassic sponge-beds.

10. Test fixed, irregularly shaped, spheroidal, cylindrical, or conical. Papillæ generally few in number, variously disposed all over the surface of the chamber. Cement usually hyaline. Attached to the tubes of *Hyperammina vagans*, Br., rarely to *Placopsilinæ* or other fossils (figs. 27, 30, and Q. J.

* Brady, *l. c.* p. 27, tab. v. fig. 9.

G. S. xxxix. tab. iii. fig. 6). Not common in the Lower Argovian beds.

11. Test fixed, more or less cylindrical, small, bearing a small number of short papillæ regularly disposed round the margin of the chamber. Cement hyaline. Rare, in the Upper Jurassic sponge-beds (fig. 28, and Neues Jahrb. 1883, tab. iv. fig. 12).

Brady mentions an interesting polythalamous form, two or three chambers being adherent to each other. I have not been able to find similar specimens in the Jurassic beds; but it is possible that they occur, especially in the sponge-beds, with numerous spherical varieties, but that the single chambers are broken off during the preparation. As an interesting fact, we must mention that several specimens were found with a second interior chamber, similar to those described by Brady.

Trusting that these few remarks on a very important but still little known arenaceous form may give new proofs of the continuity of certain species and of the great variety of Foraminifera, I must express my thanks to all the gentlemen who have assisted me by sending specimens for comparison, washings from Jurassic rocks, samples of limestones, and notes on the occurrence and different varieties of *T. papillata*.

XXXVI.—*Investigations upon some Protozoa.* By Dr. August Gruber*.

[Plate XIII.]

The present memoir consists of several sections which stand in no direct connexion with each other, and extend over various regions of Protozoology. The first part is devoted to the description of some new Rhizopods, which will be found interesting in several respects; in the second some Infusoria, partly new, partly not well known, will be described; and the last section will treat of some peculiar phenomena of union in Heliozoa.

Besides the observation of the living animal, I have availed myself of the mode of preparation described by Korschelt †,

* Translated by W. S. Dallas, F.L.S., from the 'Zeitschrift für wissenschaftliche Zoologie,' Bd. xxxviii. pp. 45–70.

† "Ueber eine neue Methode zur Konservirung von Infusorien und Amöben," Zool. Anzeig. no. 109.

which has done me excellent service. This, as is well known, consists in killing the animals quickly by means of a reagent which is allowed to flow under the covering-glass, and which at the same time hardens them, after which, while still under the glass cover, they may be stained, deprived of water, and mounted in Canada balsam. For killing the animals Korschelt employed chromic acid; but other reagents which produce a rapid stiffening will serve equally well, such, for example, as absolute alcohol, hot solution of corrosive sublimate, and osmic acid. Landsberg* has recently recommended another method, namely the isolation of the Protozoans by means of a pipette, which is certainly preferable when we have to do only with the making of neat preparations for a collection, but of course cannot be employed in all those cases in which the object under treatment must be preserved *in situ* and at a particular moment, or when it is so small that it could not be detected in a watch-glass by means of low powers.

I. New Rhizopoda.

1. *Pachymyxa hystrix.*

I had long ago observed, in the coating formed by Diatoms, Oscillariæ, and other low plants on the walls of our small marine aquarium [at Freiburg i. B.], certain peculiar roundish bodies, which I at first regarded as the fæces of some worm or crustacean. On closer examination, however, there appeared to be too great a regularity in their formation, and especially in their external covering; so that I was led to suppose that these bodies were independent organisms; but of what kind I was quite uncertain, as no motory phenomena seemed to be observable. After many fruitless endeavours, however, I at last succeeded, by leaving the bodies in question for a long time undisturbed under the glass cover, in arriving at a conclusion as to their nature and ascertaining that I had before me Rhizopods, certainly of very peculiar organization.

I have not been able to discover in literature any species agreeing with this form, and must therefore create a new name for it. This will be an expression of the bodily constitution of the Rhizopod, namely *Pachymyxa hystrix.*

To the naked eye the larger examples of *Pachymyxa* appear as small white granules, which stand out very distinctly from a dark ground. In the coat of algæ growing in the aquarium

* "Ueber Konservirung von Protozoen," Zool. Anzeiger, no. 144.

we often find whole layers of light points, which are such Rhizopods. One of the large specimens that have come under my observation measured 0·6 millim. in length, with a breadth of 0·3 millim.; while, on the other hand, *Pachymyxæ* may very often be met with of a globular form and not more than 0·09 millim. in diameter. When a specimen is placed under the microscope and examined by transmitted light, it no longer appears white, but brownish.

What makes its appearance in the first place is nothing but an envelope which surrounds the protoplasmic body of the Rhizopod. This envelope consists of a layer of closely approximated fine bacilli, which stand about perpendicularly to the surface of the protoplasmic body; they form a sort of felt, or, more properly, a completely closed spiny coat. I have not succeeded in ascertaining of what substance these spines consist. In chromic acid they dissolve immediately, while they remain entirely unaltered on the addition of osmic acid, for which reason the latter reagent was always employed when it was intended to make a permanent preparation.

I had a notion that the spines might consist of carbonate of lime, but could not succeed in confirming this supposition by means of reagents.

This much, however, is certain, that the bacilli are not foreign bodies collected and fitted together, but are a product of the protoplasm itself. On examining the surface, we find that the coating is not completely closed, as it at first appears, but that in many places the bacilli separate and leave gaps between them. These are circular apertures, pretty regularly distributed, which perforate the envelope. In fig. 1 the bacilli on the surface appear depressed and somewhat displaced by the pressure of the glass cover, whilst at the periphery they show themselves in their regular position. It might be expected that the pores would appear as gaps at the margin; but this is not the case, because here the pore is not sharply limited, on account of the bacilli lying beneath it.

These pores are seen both in the living animal and in the empty envelope and the osmic acid preparation. They first led me to the supposition that in these little masses I had before me a Rhizopod which, perhaps, like a Foraminifer, could emit pseudopodia through the pores of its envelope. But the vital phenomena of *Pachymyxa* are so sluggish that the animals when taken from the aquarium and placed on the object-slide usually remain motionless in their envelope.

I was already beginning to regard any further investigations with despair, when, to my delight, I met with a specimen from which a number of pseudopodia radiated (fig. 1).

whi'I supposed, they issued from the pores of the envelope, although this could not always be demonstrated with certainty. In the figure, which is drawn from life, the pseudopodia are seen only at the periphery; and this is generally the case, either because we cannot detect the pseudopodia issuing from the upper surface, or because the overlying covering-glass here stands in the way of an issue of the sarcode.

As regards the form of the pseudopodia, it is such as to indicate for *Pachymyxa* a position among the Lobosa. It differs, however, from the ordinary form in that the pseudopodia are not lobate often-changing processes of protoplasm, but threads of uniform thickness from the base (*i. e.* from their point of issue) to the tip, and never exceeding a certain length, which can bend slowly to and fro. They most resemble those of *Orbulinella smaragdea* described by Entz *, as this is reproduced by Butschli in 'Bronn's Klassen und Ordnungen des Thierreichs' (Protozoen, Taf. iv. fig. 4). In this also the pseudopodia issue from pores of the shell †.

I have never observed any branching in the pseudopodia. Usually they are all of equal thickness; and only occasionally, when the animal flattened itself, were broader processes seen to issue from some points. No protoplasmic flow is observable in the pseudopodia; and they consist of perfectly hyaline sarcode without any granules. They appear not to be organs of locomotion; for I have never observed that the *Pachymyxa* effected any change of place by their means. The processes evidently serve only to collect and convey to the body nutritive materials.

Unfortunately I have never succeeded in seeing the *Pachymyxa* take nourishment, and consequently can offer no explanation of the fact that one sees in its interior food-balls which are much too large to be incepted through the apertures of the envelope. It is quite possible that substances originally finely divided are afterwards balled together in the interior of the Rhizopod into such masses.

As regards the protoplasmic body itself, this, even in the living animal, shimmers through the envelope; and its contour is seen to reach to the bacilli. At the points where pseudopodia issue the strong refractive power betrays a layer of hyaline protoplasm, from which the processes are produced, whilst within the body consists of a turbid sarcode abundantly furnished with granules and vacuoles. It is likewise frequently quite full of dark brown food balls. The whole mass is exceedingly tenacious and dense, so that scarcely any thing

* Naturh. Hefte des ungar. Nat.-Mus. i.

† Entz's memoir has unfortunately not been accessible to me.

of a flow or movement is to be observed in its interior. Nevertheless, when observed for a long time, distinct, although slow, changes of form, in which the spiny part shares, make their appearance. For example, the Rhizopod acquires a band-like form instead of being globular as before; and thus it appears to increase in length under the eye of the observer. In this way it frequently extends itself so much that the bacilli become more widely separated from each other; and thus the view of the interior becomes freer. Such specimens are particularly well adapted for the study of the issue of the pseudopodia from the pores.

In figure 2 I have represented a *Pachymyxa* which has rolled the middle part of its body into a spiral form, having been at first globular and then band-like. We distinctly see the folds which the envelope makes over the tough protoplasm. Soon after the animal had acquired this form it suddenly unrolled itself again, and then slowly regained a rounded form.

But we obtain a better knowledge of the structure of *Pachymyxa* and of the relations of the protoplasm to the envelope than from the living animal by making preparations in which the animals, after being killed with osmic acid, are stained with a solution of carmine and finally mounted in Canada balsam. In the first place, we find that in this process the bacillar envelope is separated as a whole from the protoplasmic body, or the latter contracts from it. From this we see that, although during life this envelope is so closely united with the sarcode that it has to accompany it in all its movements, the bacilli are nevertheless seated upon a special excessively thin outer layer, somewhat like a cuticle, which, however, in life does not separate from the rest of the protoplasm. I have obtained preparations in which this fine membrane had actually become dark-coloured, and thus became very distinctly visible.

At the points where the pores are situated there must of course be a gap in this outermost layer of protoplasm; *i. e.* it is no doubt perforated by each pseudopodium that issues forth, to be formed afresh as soon as the pseudopodium is again retracted. We cannot generally succeed in obtaining a preparation with extended pseudopodia; but on some few occasions I have managed this; and the conditions were particularly distinct so long as the *Pachymyxa* continued lying in the staining-fluid, and therefore before the alcohol had exerted its contractive influence. Figure 3 is drawn from such a preparation. We see in it the bacilli of the envelope far removed from the body and a pseudopodium issuing through a pore. We further see at this point the layer of hyaline protoplasm

...ch, as already mentioned, always occurs where pseudopodia are formed. This has been more strongly coloured by the carmine than the underlying mass of granular sarcode. Scattered through the latter we observe a great number of granules or spherules, also dark-coloured, upon which I must here give some more details.

In all the *Pachymyxæ* that I have examined (and there were a great number of them) I have never been able to observe any trace of a nucleus; but, under the right treatment, the above-mentioned red points, relieved by their darker colour from their surroundings, nearly always made their appearance. Now it seems not improbable that the red granules represent small nuclei, as, indeed, we meet with a multiplicity of nuclei in other Rhizopods, in *Pelomyxa* for example. In favour of their nuclear nature we have likewise the behaviour of the granules towards reagents, and especially their rapid staining by carmine; this, however, is not a certain proof; and, unfortunately, I am unable to offer any such.

In what relation these possible nuclei stand to reproduction I could not ascertain; but one preparation led me to suppose that they might perhaps give origin to an endogenous division, or, more properly speaking, to a formation of swarmers. Thus in a *Pachymyxa* treated as above described, but in which the protoplasmic body had only become very slightly stained, I met with a considerable number of dark red granules. All these, however, were surrounded by a zone of hyaline protoplasm, also very strongly stained, so that they appeared like small *Amœbæ*. They lay scattered in the sarcode, just like the cells formed internally during the segmentation of the ova of many insects* (e. g. *Gryllotalpa*).

I could never observe the issue of such corpuscles from a *Pachymyxa*; but in my preparations I have often found among the Algæ very numerous little amœbiform creatures of exactly similar structure, which might perhaps be related to them.

But even if a reproduction of *Pachymyxa* by swarm-buds should actually occur, this is not its only mode of propagation; for an increase by division certainly also takes place. We often find specimens which are in process of breaking up into two parts by a constriction taking place in the middle, as indeed might be expected *à priori*†.

Finally, as regards the position of *Pachymyxa* in the sys-

* In several preparations which I had afterwards the opportunity of making, the corpuscles in question occurred in exactly the same way.

† A breaking-up into a greater number of small pieces also seems to me probable.

tem, I must admit that I am not in a position to range it with any previously known form. In the formation of the pseudopodia it has perhaps the greatest resemblance to *Orbulinella*. As regards the peculiar envelope consisting of fine bacilli, I can indicate no analogue of this. The only thing that has struck me is its resemblance to the coating of fine processes which Archer* has described in his *Diaphoropodon mobile*; but in the latter form the little rays are pseudopodia, and not rigid bacilli.

The completely closed envelope, traversed by pores, indicates a distant resemblance to the Perforata among the Foraminifera; while its want of consistence and the form of the pseudopodia, as well as the whole structure of the protoplasmic body, rather refer *Pachymyxa* to the amœbiform Rhizopods.

Together with the form that I have just described, there was also in the marine aquarium at the same place a number of naked masses of protoplasm, varying in size between about the dimensions which I have given above for *Pachymyxa*. These creatures, with regard to which I will hereafter endeavour to decide whether they are identical with *Pachymyxa* or not, show many interesting pecularities; so that I must give a detailed description of them.

In these also the protoplasm is characterized by its tenacity and density, so that none but extremely slow, scarcely visible, phenomena of motion are exhibited by it. These Rhizopoda are consequently also very opaque, especially if, as is frequently the case, they are filled with large brown food-masses. Very frequently such nutritive constituents are enclosed in the interior of a special large vacuole or digestive cavity, sharply marked off from the surrounding parts. At other times the balls lie scattered through the inner parenchyma of the body.

In general the external appearance of the individual specimens may be exceedingly different, as the protoplasm may at one time acquire an entirely granular texture, and at another a vesicular consistency full of vacuoles, and lastly appear hyaline and transparent. Very frequently a division into an external clear layer of protoplasm and an endoplasm filled with nutritive constituents may occur, the latter then representing a sort of nutritive paste. Such specimens (fig. 4) show a very regularly vacuolar exoplasm, from which the pseudopodia issue. The outer layer here exactly resembles that of an *Actinophrys sol*. Within it the endoplasm, coloured brown by the nutritive paste, is seen sharply differentiated.

* Quart. Journ. Micr. Soc. new ser. ix.; see also Bütschli, in Bronn's Kl. und Ordn. des Thierr. Taf. iv. fig. 1.

On one side of the individual figured (fig. 4) a second smaller one is seen to be attached; it is in process of fusion with the larger one, just as we shall observe hereafter in *Actinophrys*. Here only the endoplasm, *i. e.* the nutritive paste, was, in the first place, absorbed by the larger Rhizopod. The whole of the brown contents of the smaller individual flowed in a slow but constant stream into the larger one, so that finally there remained of the former only a clear mass of protoplasm, rich in vacuoles, but destitute of any nutritive particles, and from which also the pseudopodia had disappeared.

So long as I could observe the two specimens no complete fusion had taken place; but remarkable changes occurred in the larger Rhizopod. It entirely lost its regular form. The brown contents became balled together in several masses; the outer layer dissolved, so that in some places there remained only a fine zone which was pushed outwards by large vacuoles; in short, the form of the whole creature became exceedingly irregular, as if it were about to break up. Soon afterwards, however, it gradually approached the original form, which it finally almost completely resumed.

From this we see how little constancy there is in the separation into two regions in the Rhizopoda, and how easily plasmas temporarily appearing separated may become mixed together. The changes which have taken place in one and the same individual also furnish an indication why the forms here under consideration may be so different in respect of the structure of their protoplasm.

The behaviour of the pseudopodia is very remarkable. They do not issue as simple processes from the outer layer of protoplasm, but come forth as fine rods of uniform thickness from a cone of hyaline sarcode, exactly in the same way that I have recently described in the case of *Amœba tentaculata**. Here also the filament issues exactly from the apex of the cone; and when it is again retracted, there always remains a small cup-shaped depression. The pseudopodial cones, however, are usually much more numerous than in *Amœba tentaculata*, and also generally arranged with remarkable regularity (fig. 4).

In the above-mentioned *Amœba* the whole body, including the pseudopodial cones, appeared, under a high power, to be surrounded by a distinct double contour, which is not the case here, or, at least, could not be observed in by far the greater number of cases. Nevertheless here also, as in *Pachymyxa*,

* "Beitrage zur Kenntniss der Amöben," Zeitschr. fur wiss. Zool. Bd. xxxvi.

which is furnished with an envelope, there exists an extremely fine layer of protoplasm as a coating over the whole body. I have previously asserted* that in all Rhizopoda the outer limit of the protoplasm acquires a different consistency by contact with the water, and that the flow of an *Amœba* or of a pseudopodium consists in a continuous breaking through this external membraniform layer on the part of the fluid sarcode yielding to a pressure, during which this layer is constantly being formed anew.

In most Rhizopoda this is not to be seen; and even in the present case we perceive nothing of it in the living animal. But this sort of cuticle is shown only the more distinctly by the application of reagents. Thus, if we kill the Rhizopods with osmic acid, stain them with carmine, and mount them in Canada balsam, the protoplasm contracts, and we see a fine membrane separated from it and reproducing its contour. If the preparation is successful, the pseudopodial cones with the pseudopodia themselves are preserved. In the fine membrane we then see very distinctly elevations at many points, each corresponding to a subjacent cone—a proof that the membrane, as a delicate layer, has enveloped the cones also, and been perforated by the pseudopodia. Here also I could never detect a nucleus; but with proper preparation and staining there appeared the same numerous red granules in the interior as in *Pachymyxa*. As in this, also, reproduction by division appears to be frequent.

The next question is where, from the characters described, we have to seek the allies of this Rhizopod. The most obvious course, perhaps, is to regard it as identical with *Amœba tentaculata*, which I also discovered at the same spot in our marine aquarium. Size cannot come into consideration in the comparison, as it is very variable in the different specimens; on the other hand, the phenomena of movement in *Amœba tentaculata* were quite different. The stage in which it emitted the pseudopodia described only represented a resting state, whereas otherwise it could pass into a constant flow, just like other *Amœbæ*, especially *Amœba quadrilineata*; moreover it possessed a distinctly visible typically formed cell-nucleus, both things which never came under observation here. It might indeed be assumed that this Rhizopod is a developmental stage of that *Amœba*, but this is very improbable.

But as regards the connexion of the form under consideration with the above-described *Pachymyxa*, the supposition seems almost inevitable that it is identical with the latter;

* *Loc. cit. suprà.*

for, leaving out of consideration the absence of a clothing with the small bacilli, the two forms have a number of agreements—such as the tenacious consistence and slight mobility of the protoplasm, the occurrence of numerous nucleiform corpuscles in the interior, the enclosure in a fine firm layer of protoplasm which, by a certain mode of preparation, stands forth like a cuticle, the form of the pseudopodia, and finally the mode of division. The only differences therefore are, that in one form pseudopodial cones are always formed, and that in the other the little bacilli of the skeleton are seated upon the peripheral layer of sarcode. I would therefore regard the last-mentioned Rhizopod only as another state of *Pachymyxa*.

2. *Amœba obtecta*.

Besides the *Pachymyxa* just described, I also found, in the small marine aquarium of the Zoological Institute here, another form of Rhizopod, and indeed an *Amœba*, which differs in many respects from the other species of its genus; and I have named it *Amœba obtecta*. It is very small, measuring only 0·03–0·04 millim., and does not creep freely about, but constructs a dwelling in which it conceals itself. As regards the latter, it is formed of a mucous substance of yellowish colour, which seems to harden more and more in water. The innermost part of the envelope which lies nearest to the *Amœba* is the firmest and the darkest-coloured; it forms the true carapace, while around it may lie an irregular zone of the yellowish substance, to which numerous granules and other foreign bodies firmly adhere.

In composition and coloration the substance of the envelope exactly resembles that which I have described in *Stichotricha socialis**. As regards its form, the carapace is basin-shaped (fig. 5); *i. e.* it possesses a rounded bottom and a wide aperture for the issue of the protoplasm. Frequently one half of the side wall has not been developed; and then the *Amœba* lies rather loosely in a simple saucer. The protoplasmic body which shelters itself in this envelope shows nothing remarkable that would distinguish it from the allied species of *Amœba*. The sarcode is tolerably tenacious and immobile, although far less so than in *Pachymyxa*. The portion that lies in the bottom of the basin is finely granular and turbid, while the opposite end, situated at the aperture, is clear, and appears formed of a hyaline mass. The pseudopodia originate from this; but I have only rarely been able to observe them, as the *Amœbæ* do not readily recover from the disturbances which

* "Neue Infusorien," Zeitschr fur wiss Zool. Bd. xxviii.

they undergo by their transfer to the object-slide. Generally we see only slow alterations in the hyaline mass; but once I succeeded in observing true pseudopodia (fig. 5). These were obtuse processes, one of which was forked at the end. Their movements were very slow. Such a specimen had thus some resemblance to a monothalamian Rhizopod. Nothing is to be seen in the living animal of a nucleus or a contractile vacuole. The latter is probably not present at all, as *Amœba obtecta* is a marine form; the nucleus, however, may be rendered very distinctly visible by means of reagents.

If the *Amœbæ* be treated in the fashion described at the beginning, and then stained with picrocarmine, the intensely reddened nucleus makes its appearance distinctly, even in a short time. It is seen sometimes at the posterior end of the body, sometimes in the middle, and it always appears as a uniformly red-coloured mass. The vacuoles in the protoplasm are also very well preserved under this mode of treatment.

As to the mode of reproduction of this *Amœba* I possess no observations. It certainly takes place by binary division; and the portion issuing from the shell will probably at once form a new envelope for itself. This seems to be shown by the circumstance that we very often find pairs of *Amœbæ* which lie with their carapaces quite close together.

These Rhizopods have evidently no tendency to undertake migrations, and hence, when the conditions are favourable, lie together in great quantities, and thus form regular societies.

[To be continued.]

XXXVII.—*On the Oœcium of* Spiralaria florea, *Busk*. By J. J. Quelch, B.Sc. (Lond.), Assistant, Zoological Department, British Museum.

The genus *Spiralaria* was established by Prof. Busk for the reception of the beautiful and curious Australian Polyzoon which he described and figured under the name *Spiralaria florea* in the 'Quarterly Journal of Microscopic Science,' new series, vol. i. (1861) p. 153. The same species has since been redescribed and figured by Prof. M'Coy in the 'Prodromus of the Zoology of Victoria,' decade v. (1880) p. 31; and supplementary information is given as to the nature of the mouth of the cell, of the avicularia, of the margin of the cell, and of the lamina on which the cells are placed; but no mention is made by this latter observer of the occurrence of oœcia. These were absent from the specimen which was described by Prof. Busk; and as I can find no record of them

by any later writer, it seems desirable to notify their presence on specimens in the British-Museum collection.

These specimens were presented to the British Museum by the Liverpool Free Museum in May 1867, and were obtained from South Australia.

The oœcia are semicircular or somewhat subglobose, slightly everted at the margin, covered by the avicularia, into the cavity of which they project, and continuous with these at their basal portion, which, being attached along the whole width of the cells, thus presents a very wide mouth. In all the preparations made, they occur only on those marginal cells on which the very large avicularia are placed; and owing to the superposition of these, the nature of the surface is rendered somewhat difficult to determine with certainty. It seems, however, to be smooth or slightly granulated. A reference to the figure given by Prof. Busk will help to give an exact comprehension of the relative positions of the oœcia and avicularia; it is only needed to increase the size of the marginal avicularia there given, especially the width of the basal part, and to add subglobose oœcia arising within them and continuous with them at the base.

A peculiar and interesting character of the cells, and one that is represented in the figure given by Prof. M'Coy, is the presence, along each side of the wall, of a "row of minute aculeate spines or denticles" placed opposite each other at short intervals. Seen under a high power of the microscope these are not simply *spines*, but *hooks* with the curved portion turned downwards.

It seems worth while to remark that in the figures given both by Prof. Busk and Prof. M'Coy the whole drawing has been reversed (apparently not having been reversed on the stone), so that both the suberect blunt spine which occurs on the upper *left* margin of the cells (*left* to an observer lying as it were in the cell, and looking through the mouth) and the mandibles of the avicularia, which, as Prof. M'Coy observes, all open towards the same direction (that is, towards the *left* side of the cell and the proximal portion of the zoarium), have become placed on the *right*.

XXXVIII.—*On a small Series of Lepidoptera from Corea.* By Arthur G. Butler, F.L.S., F.Z.S., &c.

A small packet of Lepidoptera has just been received from Lieut. Alfred Carpenter, of H.M.S. 'Magpie,' of which, as it

contains additions to the Corean fauna, it seems worth while to publish a list.

Rhopalocera.

1. *Pararge erebina*, sp. n.

Nearly allied to *P. deidamia* (*Menetriesii*, Brem.), but readily distinguished as follows:—primaries more produced, the subapical ocellus four times as large, surrounded by a pale zone in the male and a white one in the female; below this ocellus upon the disk are two small spots placed obliquely, those of the male a little paler than the ground-colour, but those of the female white and representing the lower half of the zigzag white band in the female of *P. deidamia*: on the under surface the sexes do not differ from each other to any thing like the extent that they do in *P. deidamia*; they approach most nearly to the male of that species in pattern, but differ in having a white submarginal stripe in the male and two in the female, also in the larger white-zoned ocellus on the primaries. Expanse of wings, ♂ 56 millim., ♀ 54 millim.

♂ ♀. S.E. Corea in October.

I have compared these examples with seven specimens of *P. deidamia* in the Museum collection from Japan.

2. *Lycæna argia.*

Lycæna argia, Ménétriés, Cat. Mus. Petr. Lep. ii. p. 125, pl. x. fig. 7 (1857).

S.E. Corea in October.

3. *Terias subfervens*, sp. n.

Nearly allied to *T. Jægeri* of Japan, with which it agrees on the upper surface; on the under surface, however, the costa and apex of the primaries, and the entire surface of the secondaries, are of a reddish gravel-colour, deeper even than in the males of *T. læta*. Expanse of wings 40–41 millim.

South coast, "Carzodo Island," S. Corea, November 19th.

The above differences are based upon three examples compared with seven of *T. Jægeri*; of the latter, however, I have examined about fifty specimens, and never found any thing at all approaching *T. subfervens* in the coloration of the under surface.

4. *Papilio xuthus*, var.

Papilio xuthus, Linnæus, Syst. Nat. 1, ii. p. 751. n. 34 (1767).

S.E. Corea, late in September.

A worn specimen of a dwarfed form approaching *P. xuthulus* both in size and the narrower black border of secondaries.

HETEROCERA.

5. *Macroglossa stellatarum.*

Sphinx stellatarum. Linnæus, Syst. Nat. 1, ii. p. 803. n. 27 (1766).

S.E. Corea and Tsu-Sima Island, Corean Straits, in September, October, and November 1882. "Very active; flies about by day."

The three examples sent were attacked by mites on the way, and arrived in fragments; only one was sufficiently perfect to be worth mending.

6. *Hymenia fascialis.*

Phalæna (Pyralis) fascialis, Cramer, Pap. Exot. iv. pl. 398. O (1782).

S.E. Corea in October.

XXXIX.—*Descriptions of new Species of Coleoptera belonging to the* Rhipiphoridæ. By CHARLES O. WATERHOUSE.

Emenadia sodalis, n. sp.

Atra, subopaca; capitis vertice bene elevato, truncato; thorace crebre punctato, basi fortiter bisinuato, lobo mediano supra lævi; elytris crebre punctatis, ad apicem confertim rugulosis; abdomine sublævi, rufo, segmentis ultimis cyaneis. ♂.

Long. 7½ lin.

Head very thickly and rather strongly punctured, with the slight swelling at the insertion of the antennæ smooth, and with two smooth spots between the antennæ; there is a slightly elevated line in the middle which extends nearly to the vertex. The vertex is very much elevated, truncate at the apex, with the lateral angles slightly prominent. Thorax evenly convex, closely and moderately strongly punctured (except the basal lobe), the posterior angles rather abruptly diverging so as to embrace the elytra, acute, and with the extreme apex directed backwards. The one side of the basal lobe makes with the other side an angle a little less than a right angle, the apex itself slightly blunted. Elytra rather long, flattened dorsally, obliquely impressed near the base, with a small round (not very conspicuous) tumour near the

scutellum, very acute and much diverging, thickly punctured at the base, all the apical portion longitudinally finely rugulose and punctured. The metathoracic parapleura shining, the punctuation very distinct and moderately close, not at all crowded. The abdomen is shining, finely punctured, the punctuation only moderately close, the middle and margins of the segments smoother. The pygidium and propygidium cyaneous, closely punctured, the margin of the propygidium smooth. Claws pitchy.

One of the examples has the posterior angles of the thorax and the base of the elytra pitchy brown.

Hab. Madagascar, Fianarantsoa (*Rev. W. Deans Cowan*).

Emenadia armata, n. sp.

Nigra, subopaca, subtus nitida; capite crebre punctato, vertice fere lævi; thorace confertim punctato, lobo basali apice acuto elevato; elytris sat brevibus, divergentibus, flavis, basi anguste, apice late nigris. ♂.

Long. 6 lin.

Head in front closely and distinctly punctured, the forehead less closely and more finely punctured, with a short smooth central line; the vertex moderately elevated, obtusely rounded, very slightly emarginate, smooth. Thorax moderately convex; very closely, rather strongly punctured (the punctures near the base rather elongate and subconfluent); gradually narrowed from the base to the front, the sides slightly flexuous; the posterior angles a little less than right angles, not projecting. The base impressed on each side of the middle lobe; the lobe itself longitudinally raised, the apex very acute and slightly turned up. Elytra very acute at the apex and much diverging, the disk with a broad, shallow, longitudinal impression; yellow, with the extreme base and the apical third black; the punctuation is moderately strong and very close, the punctures have a tendency to unite longitudinally. Metathoracic parapleura shining, very distinctly and moderately thickly punctured, the punctures not at all crowded. Abdomen a little more thickly punctured than the parapleura. Claws pitchy.

Hab. India, Coimbatoor (*M. J. Walhouse*).

Emenadia tricolor, ? Gerst.

Nigra, parum nitida, crebre punctata; capite fere lævi, vertice obtuse rotundato; thorace antice paulo angustato, lobo basali ad apicem rufo, truncato, angulis posticis acutis retrorsum directis, rufis; elytris fascia communi lata flava; antennarum articulo basali palpisque testaceis; tibiis et tarsis anterioribus ferrugineis; abdomine rufo-piceo, pygidio nigro. ♂.

rufa; elytris nigris, fascia communi lata flava; coxis tarsisque posterioribus et pygidio nigris. ♀.
Long. 4 lin.

The specimens from which the above descriptions are taken are probably referable to *E. tricolor*, Gerst. (Mon. p. 28). He only describes the female, and the specimens of that sex in the Museum collection differ from his description in having the femora entirely red; on the other hand he does not mention that the posterior coxæ and the pygidium are black.

The male, from its totally different coloration, might be easily mistaken for a distinct species.

Hab. Swan River.

The following allied species appears to be undescribed :—

Emenadia sobrina, n. sp.

Elongata, sat angusta, subopaca, atra; thoracis basi elytrisque obscure rufo-piceis, tibiis posterioribus tarsisque piceis. ♀.
Long. 3½ lin.

Closely resembles *E. tricolor*, but distinctly narrower and differently coloured. Head orbicular, smooth, the vertex rounded. Thorax not much narrowed in front, the posterior angles not diverging, very acute and directed backwards; the basal lobe truncate at the apex. Elytra brown, diverging only at the apex, longitudinally impressed on the disk. The punctuation rather close, the punctures rather elongate. One example has the apex blackish. The basal joint of the antennæ and the palpi pale. Sometimes there is a little brown on the front margin and sides of the thorax, as well as on the side of the metathoracic epimera.

Hab. Melbourne.

PROCEEDINGS OF LEARNED SOCIETIES.

DUBLIN MICROSCOPICAL CLUB.

February 16, 1882.

Cosmarium from Deeside, sent by Mr. Bissett, approximating C. cymatopleurum, Nordst.—Mr. Archer showed a *Cosmarium* of large size from Deeside, Aberdeen, collected by Mr. Bissett, of Banchory, coming near *Cosmarium cymatopleurum*, Nordst., but seemingly not quite identical therewith; but Mr. Archer had no doubt it was one and the same thing with a form found by himself on a few very rare occasions in Ireland. He had only once met with what appeared to be the true *C. cymatopleurum*, in a rocky place on the roadside by Loch Tay, in Scotland. The present form agreed in

size; but it is more constricted under the upper angles, and the lateral undulations are stronger. Mr. Bissett and Mr. Roy seemed to hold that this was truly distinct from Nordstedt's form.

Alliospora sapucayæ, n. g. et sp., Pim.—Mr. Pim showed a remarkable black mould from the kernel of a Sapuçaya-nut, which will most probably form the type of a new genus. It forms a dense black velvety mycelium on the kernel of the nut, giving off numerous fertile hyphæ. These appear under the microscope of a very deep brown colour and somewhat septate. The heads are globose with chains of spores, much resembling some of the smaller forms of *Aspergillus*. The chains of spores, however, instead of being attached end to end, as in that genus, like a string of beads, arise from extremely delicate threads, reminding one of miniature onions on a hank. The fertile hyphæ have very strongly marked side walls. In allusion to the onion-like arrangement of the spores, Mr. Pim would suggest as a provisional name *Alliospora sapucayæ*.

Section of Shell of Limax maximus.—Prof. Mackintosh exhibited the shell of *Limax maximus*, a specimen he had found in the month of December. The shell showed on its upper surface numerous small spicules, which in some places were separate, in others grouped in rosettes; and near the margin of the area were to be seen large polygonal crystals, apparently like those of which the bulk of the shell is composed. Prof. Mackintosh supposes that the spicules represented the first deposits of calcium carbonate laid down when the secreting-power of the cells was but slight, and that as the season opened and the increasing warmth stimulated the vital functions the larger crystalline deposits made their appearance and superseded the lower spicular growth.

Sections to illustrate multiple Staining.—Mr. B. Wills Richardson exhibited sections in part illustration of a paper on multiple staining, published by him in last December's number of the Journal of the Royal Microscopical Society, viz.:—

No. 1. A true double-staining of a transverse section of Sugarcane, in atlas scarlet and soluble blue.

No. 2. Quadruple-staining, in atlas scarlet, soluble blue, iodine, and malachite greens, of stem of Bignonia.

No. 3. A section of Potato in atlas scarlet and a mixture of iodine and malachite greens, the malachite green being in excess. In the specimen the starch-grains are rich green, and the walls of the loculi a very delicate scarlet.

Section of Manus of Human Fœtus, and Structure.—Dr. B. C. Windle exhibited three sections taken from the manus of a fœtus of 5 centim. head and buttocks measurement. They pass respectively through the second row of the carpus, through the proximal ends of the metacarpal bones, and through about the middle of the same bones. The first section, viz. that through the second row of the bones of the carpus, shows the following points:—

Bones. At first there was some difficulty in determining exactly which bones appeared in the section; but the following description is correct. To the ulnar side lies the unciform, easily recognizable by its hook-like process. Proceeding from it, the next bone in order is the os magnum, then the trapezoid, and finally the trapezium. The latter appears to have a division in it; but this is not of any importance.

Tendons. In the groove of the trapezium lies the tendon of the flexor carpi radialis. At the most superficial part of the palmar surface the tendon of the palmaris longus appears as a faint line. In the centre lie the tendons of the flexors of the fingers.

Annular ligament. The annular ligament can be seen stretching from the hook-like process of the unciform to the trapezoid, and sending a slip to the trapezium.

Muscles. On the radial side the abductor pollicis, on the ulnar side the abductor minimi digiti.

Vessels &c. Ulnar nerve and artery in the angle between the annular ligament and the abductor minimi digiti.

The second section, which passes through the bases of the metacarpal bones, shows:—

Bones. The first and second metacarpals are narrower on the palmar than on the dorsal aspect, the dorsal aspect of the latter being rounded, whilst that of the former is angular. The third roughly resembles one of the forms of shields on which coats of arms are depicted. The fourth and fifth are approximately round.

Muscles. In the thenar region, most externally the abductor pollicis, next to it the flexor brevis pollicis, then the opponens pollicis, separated from the last by the tendon of the flexor pollicis longus, and finally, deepest of all, the adductor pollicis. In the hypothenar region, externally and quite distinct from the other muscles, there is the abductor minimi digiti. Closer to the bone, on its ulnar aspect, is the flexor brevis minimi, whilst on the palmar aspect a few fibres represent the opponens minimi digiti. The line of demarcation between these last two muscles is difficult to make out. In the centre of the palmar aspect two lumbricales can be seen.

In the third section, which passes through the centre or nearly so of the metacarpal bones, attention is drawn to the following points of interest:—

Bones. The first metacarpal roughly resembles the figure conventionally supposed to represent the heart, save that it is broader and its apex (which is dorsally directed) blunter. The second and fourth are nearly circular, and the third and fifth approximately oval. By far the greatest distance between any of the bones is that which intervenes between the first and second The smallest is that between the second and third, whilst the distances between the third and fourth and fourth and fifth are nearly equal.

Muscles. The adductor pollicis, attached to the palmar and partly to the ulnar aspect of the first metacarpal, can be seen extending towards the centre of the palm. On the ulnar and solar aspect of the fifth metacarpal there are two muscles, viz. nearest to the bone

the flexor brevis minimi digiti, and superficial to it the abductor minimi digiti. The line of demarcation between these two is not so distinct as it was in the former section. The full number of interossei are present, and they are arranged as follows:—The interspace between the first and second bones is almost entirely filled up with the first dorsal interosseus, which is attached to the whole radial and part of the palmar aspect of the second bone. In the second interspace there are two interossei—the dorsal, placed more completely on the dorsum of the hand than any of its fellows, and a palmar, attached to the lower portion of the ulnar aspect of the second bone. In the third interspace the dorsal interosseus lies midway between the bones; the palmar is placed on the radial and partly on the volar aspect of the fourth bone. The two interossei in the fourth interspace lie side by side; the palmar, however, curves much further round the volar aspect of the fifth bone than the dorsal does with respect to the fourth. In the centre of the palm there are to be seen three lumbricales and the tendons of the long flexors of the fingers.

Omentum of Elephant.—Mr. Abraham mentioned that, as the members were aware, the large elephant died at the Zoological Gardens a few weeks ago; and naturally he embraced the opportunity of obtaining portions of the animal for microscopic examination, knowing that little had been made out regarding the histology of the animal. Unfortunately by the time he was able, through the kindness of Prof. Macalister, to secure any pieces of tissue, decomposition had already set in; the results therefore which he had obtained were not so valuable as they would otherwise have been. Nevertheless the specimen on the table presented some interest—a piece of the omentum in a nitrate-of-silver and logwood preparation. When Prof. Macalister produced this membrane from the abdomen it was found to consist of a large bag stretching some 12 feet in length and upwards of 4 feet in diameter; in fact he was able to get inside of it. In spite of the size, the texture and thickness were as delicate as in the smallest animals; and, as in the case of the other tissues, the diameter of the histological elements was found to be by no means in ratio to the large size. The slide exhibited showed that the elephant's omentum is a beautiful fenestrated membrane.

Spicules of a new Alcyonarian.—Dr. E. Perceval Wright exhibited some mounted specimens of the spicules of a new form of Alcyonaria allied to *Primnoa.* The spicules were but feebly calcareous, were very varied in form, but in a manner that seemed characteristic, mostly flat and colourless; in the stem portion of the colonial mass they were sufficiently felted together to form a fairly solid column.

March 30, 1882.

Moss-protonema living on a Fern.—Mr. Greenwood Pim showed

examples of a protonematous growth, otherwise the primordial state of some moss, seemingly, as it were, parasitic on a fern in the College Botanic Garden. These characteristically reddish obliquely jointed filaments seemed in several places as if inserted into and for the time quasi-organically united to the fern, and issuing as hair-like adventitious structures.

Alliospora sapucayæ, Pim.—Mr. Pim further showed another state of the fungus brought forward by him at last meeting, with the strings of spores in large tufted heads.

Cosmarium cymatopleurum, Nordst., *and Scottish and Irish Forms.*—Mr. Archer showed Herr Nordstedt's specimen of his *Cosmarium cymatopleurum*, var. *tyrolicum*, also his figure of the same, as well as that of his original *C. cymatopleurum*, together with the Scottish specimens of Mr. Archer's gathering, in continuation of the exhibition at last meeting of Mr. Bissett's form taken from the hills on the Dee-side. The form *C. tyrolicum* appears, Mr. Archer thought, truly a distinct thing, and it has not occurred in Britain; so also is probably Mr. Bissett's form distinct from the true *C. cymatopleurum*.

Specimens illustrating the Development of Echinus microtuberculatus exhibited.—Prof. A. C. Haddon exhibited a series of Dr. Dohrn's preparations illustrating the development of *Echinus microtuberculatus*, very beautifully showing various stages in development, and forming as stained very handsome objects.

April 20, 1882.

Ptilopteris Mertensii.—Dr. E. Perceval Wright, in exhibiting some living specimens of *Ptilopteris Mertensii*, showed the peculiar manner in which the ramuli bearing the spores (?) broke off, and themselves grew up into perfect plants, which mode of growth had apparently not been previously described.

Xanthidium concinnum, n. s., Archer, *a minute form somewhat of a Cosmarium aspect.*—Mr. Archer showed a minute Desmid of rare occurrence, one of those, in their way, interesting forms as to which a decision was difficult as regards their generic position. When met with on the few occasions on which he had detected it, though then in some quantity, he had marked the collecting-bottle "Acute-angled *Cosmarium*;" but, as a matter of fact, and taken strictly, the form seemed to fit more properly in the genus *Xanthidium*. It is very minute (about the size of *Cosmarium tinctum*), semicells elliptico-hexagonal, the apices bearing at each side and at the upper very obtuse angles a minute but very appreciable mucro, each front surface of each semicell showing a distinct median papilla; end view compressed, showing at the middle on each side the very distinct now prominent papilla. Thus the essentials of the genus *Xanthidium* were fulfilled; for though the spines were reduced to a minimum, they were there, albeit very minute and acute: and whilst the

conspicuous central boss or elevation bordered by papillæ or ornamented by scrobiculi of the larger forms was reduced to a simple papilla, yet it too was there. It is true that many minute forms, distinctly *Cosmaria*, have a similar median papilla; yet Mr. Archer would lean to the view that, coupled therewith, the presence of the spinules at the corners must compel us to regard this form as a *Xanthidium*, of which genus it would certainly be the most minute species, and might stand as *Xanthidium concinnum*.

Specimens illustrating Development of Cotylorhiza borbonica.—Prof. Haddon exhibited a series of three slides, showing the planula, hydra tuba, and ephyra of *Cotylorhiza borbonica*, also obtained from Dr. Dohrn's zoological station at Naples.

Cliftonæa pectinata, Harv., *from Port Phillip.*—Dr. M'Nab exhibited specimens of *Cliftonæa pectinata*, Harv., found in January 1882 by Bracebridge Wilson at Port-Phillip Heads, and kindly communicated by Baron Ferdinand von Müller. The structure of the ramuli, so far as Dr. M'Nab could make out from the dried specimen, seemed to differ from that described and figured by Harvey.

Histology of Male Flower of Geonoma sarapiguensis.—Dr. M'Nab also showed a section of the centre of the male flower of *Geonoma sarapiguensis*. The stamens are developed at the end of an internode separating the andrœcium from the perianth; and at the apex three abortive carpels are to be observed. A section showed the fibro-vascular bundles regularly arranged, six going to the stamens, and three others, completely developed, to the abortive carpels. This section showed the value of the presence of the fibro-vascular bundles as indicating the existence of abortive parts.

Histology of Stem of Urvillea ferruginea.—Dr. M'Nab further exhibited sections of the stem of *Urvillea ferruginea*, a Brazilian plant belonging to the natural order Sapindaceæ. The stem was triangular, with a longitudinal row of hairs at each angle; it contained a ring of united fibro-vascular bundles in the centre, with a pith, the bast showing the bast-vessels with great clearness, whilst the bast-fibres were wanting. Three double bundles were developed, one at each angle of the stem; and a ring of sclerenchyma surrounded the stem a short distance below the epidermis. Collenchyma existed in six patches, one at each angle and one in the middle of each face.

Drawings of various Starch-granules.—Mr. William Allen showed some excellent shaded drawings made by himself of a variety of starch-granules, a comparative collection of which he was forming; these sketches very graphically showed the characteristics of each.

Foraminifera from Dublin Bay.—Mr. Balkwill showed a large collection, beautifully mounted and named, of shells of Foraminifera, chiefly from Dublin Bay; several of these slides contained as many as fifty or one hundred species, the names photographed alongside the specimens, and mounted with the greatest neatness on dark-ground slides.

BIBLIOGRAPHICAL NOTICE.

Monograph of the Turbellarians.—1. *Rhabdocœlida.* By Dr. LUDWIG VON GRAFF, Professor of Zoology at the Forestry Institute, Aschaffenburg. Leipzig: W. Engelmann, 1882. [*Monographie der Turbellarien &c.*]

THIS handsome folio volume of 442 pages is accompanied by an atlas of twenty plates of admirably drawn figures, and is further illustrated by upwards of thirty woodcuts interspersed in the text. It is an excellent specimen of German scientific work, the result of nearly five years of uninterrupted labour. It contains not only a description of all the known species of the Rhabdocœlidan suborder of Turbellarians, but a full account of the structure of these animals. Whether it will be followed by a similar volume devoted to the other suborder (Dendrocœlida) depends, as Prof. v. Graff states in his preface, upon what Dr. Lang may publish on, or in connexion with, the Turbellarians of the Bay of Naples.

First in the volume before us we have a complete bibliography, comprising no fewer than 396 articles. This is followed by an account, filling 137 pages, of the anatomy and physiology, under the heads of the integument, the parenchyma-tissue, the digestive apparatus, the water-vascular system, the nervous system, the sense-organs, and the reproductive apparatus. The geographical distribution is then treated of. Then comes the systematic portion of the work, prefaced by a conspectus of the suborders, tribes, families, and genera. Forty genera are defined, and 267 species are described; but of these some 68 are more or less imperfectly known. Three useful indices close the work. Prof. v. Graff has been fortunate in obtaining aid from many quarters: thus Prof. Semper sent him notes and specimens collected at the Philippines; Dr. P. Langerhans has furnished him with similar material obtained at Madeira and Teneriffe; and the assistance of many other persons is acknowledged.

The Turbellarians form a class or order of small animals with soft bodies, living for the most part in the sea, though a few species have been found in fresh water. They are bilaterally symmetrical, destitute of transverse rings or segments, and without respiratory or circulatory organs. The integument consists of a ciliated epithelium, and contains a continuous muscular sac as well as nettling capsules. They have a mouth, but no vent. With few exceptions they are hermaphrodite; and some species have the power of multiplying by transverse fission. There are two subclasses or suborders, one of which, the Dendrocœlida (not here described), is distinguished by its species having a dendritic or reticulated and branched stomach and flat more or less leaf-shaped bodies. The female glands are always compact. The Rhabdocœlida, the subject of this work, form the other suborder, and are known either by their being destitute of a stomach, or by the stomach being when present simple and straight, or sometimes of a lobed shape. The female glands are

either wholly or in part follicular. These bodies are small, elo gate, for the most part round in section, seldom flat. Prof. v. Graff divides the Rhabdocœlida into three tribes:—

Digestive tract and parenchyma-tissue not differentiated; nervous system and excretory organs absent. 1. *Acœla*, with five genera.

Digestive tract and parenchyma-tissue differentiated; nervous system and excretory organs present.

2. *Rhabdocœla*.—Body-cavity usually spacious, with little parenchyma-tissue, by which the simple stomach is suspended. Genital glands separated from the body-parenchyma by a special tunica propria. Twenty-six genera.

3. *Alloiocœla*.—Body-cavity small, in consequence of the large development of the parenchyma-tissue; genital glands scarcely ever possessing a special tunica propria. Eight genera.

J. Y. J.

MISCELLANEOUS.

Note on the Occurrence of Ommatostrephes sagittatus, *Lam., at Eastbourne.*

Gentlemen,—There has been lately found on our shore a specimen of one of the rarest of the Cephalopoda, the occurrence of which is worth a notice in your Journal. This is the *Ommatostrephes sagittatus*, Lam., the flying squid of the fishermen. The species is considered a deep-sea form, and probably only approaches the land in order to deposit its eggs. A specimen is recorded to have been taken off Brighton by the Dowager Marchioness of Hastings, and another by Mr. Mackie at Folkestone, by Forbes and Hanley, in 'British Mollusca,' vol. iv. p. 231; and to these localities Mr. J. Gwyn Jeffreys, in 'British Conchology,' vol. v. p. 129, adds Falmouth, Polperro, and Guernsey. The specimen found here was taken alive in a rock-pool off the Parade at Eastbourne, and brought up to a fishmonger in the town; it was nearly 15 inches long, which is about the size noticed by Messrs. Forbes and Hanley, in whose work there is a very good figure. *Octopus vulgaris*, *Sepia officinalis*, *Sepiola Rondeletii*, *Loligo vulgaris*, and *L. media* have previously been taken on our shore; and the occurrence of the *Ommatostrephes* is a very interesting addition to our local fauna.

Yours obediently,

F. C. S. Roper.

Palgrave House, Eastbourne,
March 19, 1883.

On the Habits of the Ant-Lion.

Rev. Dr. H. C. McCook remarked that, through the kindness of Mr. C. H. Baker, he had had an opportunity of observing closely some

a curious habits of the larva of *Myrmeleon obsoletus*, Say. Several of these grubs had been taken from the sandy soil of New Jersey during the month of July, and brought to the Academy at Philadelphia in a large bowl. Their pits were of the usual character—an inverted hollow cone—but were sharper at the apex than usually represented. The pit is sometimes made by a backward movement of the grub upon a spiral line which gradually closes upon the centre. The body is just under the sand during this movement; and the grains of sand which fall upon the head are continually thrown upward by a sharp jerk of the head; this motion is somewhat lateral, not unlike the "butting" of a sheep or goat.

A pit is also formed by the grub while stationary, the violent ejection of the sand by the toss of the head causing a vortex towards which the surrounding sand runs from all sides, thus naturally forming the concavity. Within this the creature lies concealed, and at once begins to toss the sand when the surface at the margin is agitated by a crawling insect. Sometimes the head and jaws are exposed; they are laid flat (as observed in these cases at least), extending horizontally, and not vertically upward as is usually shown in figures. The habit may vary in this respect.

Dr. McCook believed that the popular impression that the grub throws sand after or at an ant when it appears to be escaping from the pit is without foundation in fact. The sand is thrown up more or less violently, so vigorously at times that it appears to boil. This motion causes agitation of the superincumbent sand, which begins to move toward the centre, carrying the ant with it into the jaws of the grub. The sand was tossed up with force enough to throw it out of the bowl to the distance of seven inches on the table, even pellets as large as grains of rice being thus ejected; but it flew in all directions, on the side opposite the ant or upon the ant, quite indiscriminately.

The smallest ants introduced had great difficulty in moving over the wall of the pit, as the sand crumbled and rolled away from beneath even the light emmet-tread. One ant which escaped had a little ball of minute pellets attached to a hind foot, as though caused to adhere by moisture or some viscid substance within the pit. Others had minute grains adhering to the delicate hairs of the body at many points. The inquiry was suggested whether there is any secretion or excretion from the grub which may produce this effect and so contribute to secure the victim.

The ants show a strange fascination for the pit, even after they have escaped. A large carpenter ant (*Camponotus pennsylvanicus*) was seized, escaped, rushed out of the hole, then in and around it again and again, as though verily dazed. There is a vast deal of the "Paul Pry" in the emmet nature; but the ants were rarely observed to deliberately walk into the pit. They stopped upon the edge, when they reached it in course of their rambles about the bowl, threw up their antennæ and waved them restlessly, sometimes stretched a fore foot over the brink, sometimes retreated, sometimes

turned and began to circumambulate the pit. The agitation of the sand, slight as it was, generally (not always) aroused the [illegible] to action; and by the process already described the sand was withdrawn from beneath the feet of the insect, who slid along with the tiny sand-avalanche into the apex. There it was seized, unless, as sometimes occurred, it was fortunate enough to make its escape.

The use of the long hooked mandibles of the grub appeared in the act of seizure: the ants were held off "at arm's length," so to speak; and the grub thrashed or jerked them violently until they were exhausted. Meanwhile the efforts at defence were made futile by the distance from any vital point at which the victim was held. *Tetramorium cæspitum*, the pavement-ant, which has a sharp sting, and tried eagerly to use it, was thus prevented from doing so and made quite defenceless. So also the formidable pincer mandibles of the carpenter ant, by which she excavates her wooden galleries and decapitates her victims with the facility of a guillotine, are rendered entirely useless. This defencelessness is completed by the position of the grub beneath the sand. A carpenter worker minor seized by a hind leg bowed her body under to snap at her captor; but her jaws grasped only the gritty pellets of sand which covered the ant-lion's head, and out of which the long hooks alone projected.

The point of greatest importance in Dr. McCook's observations was the confirmation of the statements of M. Bonnet concerning the behaviour of the grub when its movements are obstructed by pebbles too large to be tossed out by the head. This statement having been seriously questioned *, the matter was tested by first dropping three pebbles, each larger and heavier than the larva, within the centre of the pit. The grub having attempted to move these in the usual manner, and failed, proceeded in this wise:—It backed up to a pebble, and placed the posterior of the abdomen against and a little beneath it, so that the sand readily dropped over the apex of the abdomen, and lay between that and the stone. A little adjustment was required to balance the pebble by getting its middle part against the end of the body; and then the animal began to back out of the pit, so pushing the pebble before, or, rather, behind it, up the side, and to a point a short way beyond the margin, where it was abandoned. A small furrow (two to three inches long) was described in the sand by the moving stone, which furrow was curved from the point of departure. The stone was kept perfectly balanced during the entire progress, which was quite rapid. Each of the three pebbles was thus removed, the grub returning each time and backing it out of the pit. The experiment was repeated a number of times, and always with the same result. Some well-rounded stones were selected, in order to make the difficulty of balancing greater; but this made no difference in the action of the larva, a round pebble being balanced and removed quite as readily as a flat one. It was

* Rennie, 'Insect Architecture,' p. 202:—"We may be pardoned for pausing before giving full credence to these details."

a curious and amusing spectacle to witness the odd little creature thus backing the accurately poised impediments out of its domicile, and then returning to put its house in order once more. The correctness of the early observations of M. Bonnet is thus fully confirmed by Dr. McCook's experiments.—*Proc. Acad. Nat. Sci. Philad.*, Oct. 24, 1882, p. 258.

On the Relations existing between Palmella uvæformis *and an Alga of the Order Confervaceæ.* By M. J. B. Schnetzler.

In May 1881 I observed in a small rivulet near Lausanne some small rounded bodies of a bright green colour, with a nodular surface; they were attached to the bottom, and presented a gelatinous consistence. These bodies were formed by a small unicellular alga (*Palmella uvæformis*, Kutz.), the globose cells of which presented a diameter of about 0·01 millim. They were gelatinized and united in colonies, accompanied by numerous diatoms and crystals of carbonate of lime. This alga was placed in a glass containing about 3 centilitres of spring-water. Besides these colonies of *Palmella*, the water contained no trace of other green Algæ. The glass was covered with a watch-glass.

Two days afterwards there issued from these gelatinized colonies of *Palmella* zoospores, which, after swimming briskly in the water, attached themselves to the walls of the glass, where they formed a green coating. These zoospores soon began to germinate, and produced green Algæ with branched filaments, the cells of which were at first cylindrical, somewhat elongated, with lateral excrescences. Perfectly identical Algæ were developed directly from the gelatinized cells of the *Palmella*.

When the water containing these Algæ had evaporated to about 1 centilitre, the cells of those Algæ which presented all the characters of Confervaceæ acquired a globose form, and, becoming detached, formed new gelatinous colonies of *Palmella*. This transformation took place at the end of August and the beginning of September.

Cienkowski* has observed that an Alga of the genus *Stigeoclonium* produces gelatinized cells, which, grouped into colonies, form a *Palmella*. Famintzin, by concentrating the solution of inorganic salts of the nutritive liquid, succeeded in producing the disaggregation of a *Stigeoclonium* and of another Confervacean into cells of *Protococcus*. The numerous observations of Cienkowski support the opinion, already expressed by Kützing and others, that the *Palmellæ*, *Protococci*, and *Pleurococci* are only phases of development of different Confervaceous Algæ.

The observation that I have just noted completes those of Cienkowski. The learned Russian botanist has seen a Confervacean become transformed into a *Palmella*, whilst I have observed the transformation of a *Palmella* into a Confervacean†.

* Instit. Bot. Jahresb. 1876, pp. 42 48.

† *Stigeoclonium* or an allied form.

The little ditch in which I found *Palmella uvæformis* is sometimes filled with running or stagnant water, sometimes perfectly dry. The metamorphoses undergone by the Algæ it contains enable them to adapt themselves to the different conditions presented by their surounding medium. The presence of crystals of carbonate of lime, indicating a great concentration of this calcareous salt in the ambient nutritive fluid, might, according to the observations of Famintzin, contribute to the disaggregation of the Confervoid Alga into a *Palmella*.—*Bull. Soc. Vaud. Sci. Nat.* xviii. p. 115; *Bibl. Univ.* January 15, 1883, *Bull. Sci.* p. 109.

On the Chromatophores of the Cephalopoda. By M. R. Blanchard.

The author has investigated the chromatophores of *Octopus vulgaris*, *Loligo vulgaris*, and *Sepia officinalis* in adult examples, and of the last-named species in the young embryo. The results obtained were identical throughout.

Kolliker, in 1844 ('Entwicklungsgesch. der Cephalopoden,' p. 71) attributed the expansion and contraction of the chromatophores to the contraction and relaxation of peculiar muscular fibres situated near these pigment-cells, but having no connexion with the chromatophores themselves; later writers (such as Harless, Keferstein, and F. Boll) have gone further, and described these muscles as inserted upon the enveloping membrane. In 1875 Harting (Niederl. Archiv fur Zool. tome ii.) showed that these radiating fibres remain perfectly motionless, and that the play of the chromatophores was not due to the contraction of any muscular fibres. He regarded the radiating fibres, of which from twelve to twenty surround each chromatophore, as so many nerve-terminations attached to the enveloping membrane of the chromoblast by a clavate extremity containing a nucleus. The membrane, he thought, was filled with a transparent liquid, within which the denser coloured protoplasm spread out and contracted under the influence of the nerves.

The author agrees with Harting and Girod that there are no such things as the radiating muscles; but as regards the opinion of the former, he has found that there is no enveloping membrane; and with it disappears the contained liquid. He says that the chromatophore of the Cephalopoda does not differ at all in its general structure from those of fishes, Batrachia, and especially Sauria (Chameleon); it is a simple connective cell charged with pigment, and possessing in the highest degree the faculty of pushing forth amœboid processes into the amorphous material which exists beneath the epidermis. The chromatophore alone is active, and the surrounding tissues take no part in the performance of its movements; and the author compares it to an Amœba loaded with pigment, living its own life independently of the skin in which it is imprisoned.

This Amœba, however, is under the influence of the nervous system, as has been shown to be the case in the chameleon by the experiments of Brücke, H. Milne-Edwards, and Paul Bert, and in the

Crustacea and fishes by G. Pouchet, while Paul Bert has proved it in the cuttlefish. The connexion of the chromatophores with the nerves has also been proved anatomically by Leydig in *Lacerta agilis*, and by S. Ehrmann in the frog (Sitzungsber. Akad. Wiss. Wien, lxxxiv. Abth. 3, p. 165). Nevertheless, according to the author, the radiating fibres observed in the Cephalopoda are not, as supposed by Harting, nerve-terminations, but careful investigation showed them to be simple fibres of connective tissue having no connexion with the chromatophores. The phenomena presented by the chromatophores are thus identical wherever these organs have been observed.—*Comptes Rendus*, March 5, 1883, p. 655.

On a Flagellate Infusorian, ectoparasitic on Fishes. By M. L. F. Henneguy.

In 1876 M. Fouquet (Arch. de Zool. Expér. tome v.) made known a curious disease which almost every year attacks the trout bred in the piscicultural basins of the Collège de France. About July an epidemic breaks out, which carries off a great number of young fry hatched during the winter, and is caused by a singular ciliated Infusorian, *Ichthyophthirius multifilii*, Fouquet, which lives parasitically upon the epidermis of the trout and of some other fish, producing an inflammation of the skin.

This year the young fry of the trout, when hatched about three weeks, and before they had entirely absorbed the umbilical vesicle, were decimated by a new malady, also due to a parasitic Infusorian. When portions of epidermis from a dying fish are examined under the microscope, their whole surface is found to be covered with small bodies implanted upon the epidermic cells, and so closely applied to each other that they do not allow the cells to be seen. These are flagellate Infusorians, which may be studied when they become detached from the epidermis. Their form is different according as they are in repose or in motion.

When fixed upon the epidermis they appear to be small pyriform cells, 0·02 millim. long and 0·01 millim. wide, with the larger end free and the attenuated one attached to the epidermic cell. The body of the Infusorian is traversed by a clear longitudinal line dividing it into two unsymmetrical parts; this line represents a groove in which is lodged a long flagellum, passing the larger end. Towards the middle there is a nucleus formed by a small, central, clear mass, surrounded by a ring of refractive substance. This nucleus is coloured by carmine and methyl-green. In the larger end there is a contractile vacuole.

When the animal quits the cell to which it was attached, it opens in the line of the clear groove, and its anterior part spreads out; it then presents the form of a little basin resembling the shell of a *Haliotis*. At the middle of one margin are inserted three flagella of unequal length, which describe a curve with the concavity inwards and then become free towards the anterior extremity of the body.

One of them is much longer than the others; and it is this that we see in the groove in the attached animal; but in this case it is recurved and directed backwards, whereas in the free Infusorian it is directed forward. The other two flagella are not seen in the state of repose, and are probably concealed in the groove. These Infusorians die very speedily if not kept in fresh water. They resemble the animals which Stein has figured under the name of *Bodo caudatus* (*Amphimonas caudata*, Duj.), and which he often saw attached to larger Infusorians. But Stein's *Bodo* has only two flagella instead of three, although he may have missed the third, which is very slender. Moreover the genus *Bodo* is not well known, and Saville Kent places in it Flagellata belonging to the family Cercomonadina, characterized by having only a single flagellum and a non-retractile caudal filament. To Stein's *Bodo* he gives the name of *Diplomastix caudata*.

If the parasite of the trout does not form a new genus, and may be referred to *Bodo*, it is certainly a new species, which may be named *Bodo necator*. That the Infusorian caused the malady was proved by placing healthy fishes in company with diseased ones; in a few days all the little fishes were dead and all covered with the parasites. The action on the skin is shown by the changed condition of the epidermic cells; and some of the parasites attach themselves to the gills, producing hæmatosis. Flagellate Infusoria which live as parasites in the interior of other animals have long been known (*Cercomonas intestinalis*, *Trichomonas vaginalis*, *Hexamita*, *Lophiomonas*, &c.); but hitherto no ectoparasitic Flagellata have been described.—*Comptes Rendus*, March 5, 1883, p. 658.

On Eudiocrinus *from the Atlantic, and on the Nature of the Fauna of Great Depths.* By M. E. Perrier.

According to Mr. Herbert Carpenter, the 'Challenger' and 'Blake' expeditions will carry the number of species of Comatulidæ to about 400. The family is so homogeneous that nearly all the species belong to two genera, *Antedon* and *Actinometra*. Three other genera complete the family; and of these two, *Promachocrinus* and *Atelecrinus*, include only three species each; and the third, *Eudiocrinus* (*Ophiocrinus*, Semper), has only four, all from the Pacific. The 'Travailleur's' dredgings add a fifth species from the Atlantic, named by the author *Eudiocrinus atlanticus*; it was dredged in the Bay of Biscay on August 16, 1882, from a depth of 896 metres.

The *Eudiocrini* differ from the other Comatulæ in having only five instead of ten arms. In *E. atlanticus* the arms are much elongated, taper very gradually, and bear long slender pinnules, upon which, as usual, the genital glands are developed. The first syzygy occurs between the fourth and fifth pieces of the arms; and the fifth bears the first pinnule: the former character distinguishes *E. atlanticus* from *E. indivisus*, Semp.; the latter from the other three

species. From the latter it is further distinguished by the number and size of the *spherical bodies* or *sacculi.* These are deficient in *E. japonicus* and *Semperi*, small and scarce in *E. varians.* The centrodorsal plate is small, hemispherical, and bears, in two rows, thirty long slender cirri, each formed of fifteen joints, the last of which is bent into a small hook. The second syzygy occurs between the ninth and tenth brachial pieces, and the others at intervals of four or five pieces; the brachial pieces bear the pinnules alternately to the right and left, except at the syzygy, where the piece above the syzygy is the only one thus furnished. The whole length of the upper surface of the arms is occupied by powerful muscular masses inserted upon transverse crests traversing the whole width of the plates. The brachial plates are alternately narrowed to right and left; the pieces of the pinnules are cylindrical and scarcely widened at their upper extremity; the first can move upon the brachial piece, and the second upon the first; but all the rest are nearly fixed. Between the long joints of the dorsal cirri the fleshy pads are very small; and generally the cirri are stretched straight out.

As regards locomotion, *E. atlanticus* is an interesting modification of the Comatula type; it cannot adhere firmly to foreign bodies, and probably spreads out its arms and cirri upon the mud at the bottom, where it has nothing to fear from the waves and currents; but the muscular masses of its arms would indicate that it can swim well. The disk is very small in proportion to the arms, not being more than 5 millim. in diameter, while the arms attain a length of 12 centim., and the cirri are from 15 to 20 millim. long. The 'Travailleur' obtained fifteen specimens of the species; but most of them are in bad condition.

Notwithstanding the simplicity of their arms, the *Eudiocrini*, far from being a primitive type of Comatulæ, are a considerably modified type. And this leads to a general remark that, if we consider the principal zoological types, it appears that the various forms they comprise may be referred in each type to a group of simple forms from which all the others are derived, these simple forms forming by gemmation colonies, the different parts of which are afterwards modified and solidarized. In the type of Sponges these simple forms occur only in the group of Calcispongiæ; among the Cœlenterata they are the hydroid polypes; among the Arthropoda the lower Crustacea depart least from the Nauplius form; lastly the Annelida may be regarded as the starting-point of a group to which are to be referred the Brachiopoda, the Mollusca, and even the Vertebrata. The representatives of these simple forms are all exceedingly rare and specifically few in the deeper regions of the sea, while they become very numerous and varied as we approach the littoral zone. And, further, in each class its most modified representatives are those which are most frequent at great depths.

The Sponges are the complex forms belonging to the Hexactinellidæ, which began to flourish only in the Secondary epoch; the corals are solitary corals or Alcyonaria, especially Pennatulidæ,

aberrant types; the Crinoids are aberrant Apiocrinidæ, *Pentacrini*, or modified Comatulæ; the Stellerida, except the *Brisingæ*, are Goniasteridæ or Astropectinidæ; the Spatangoid urchins and those with flexible tests predominate over the regular urchins, which are the most ancient forms; the Holothuridæ are those with a ventral sole and with bilateral symmetry as marked as in an Annelid; the Decapod Crustacea are the most numerous; and among the Mollusca the most ancient forms, the Cephalopoda and Pteropoda, are almost entirely deficient. All these forms are abundantly represented in the shallower zones and at the surface. The conclusion drawn from these facts by the author is that the abyssal fauna is, for the most part at any rate, a fauna which has descended from the littoral and other shallow regions, and become acclimatized at the great depths. The conditions of existence becoming more and more constant or even perfectly uniform in the deeper regions, species of the most various derivations, when they had once attained a certain zone, could spread everywhere; and thus we explain at once how the fauna of the great depths presents a very constant composition in all regions of the globe, but at the same time includes various species the analogues of which occur in the sublittoral regions of both cold and hot climates.—*Comptes Rendus*, March 12, 1883, p. 725.

Actinosphærium Eichhornii.

Prof. Leidy remarked that he had noticed in an aquarium what appeared to be eggs adherent to the edges of the leaves of *Vallisneria*, from the Schuylkill river. On examining the egg-like bodies with a lens, they were observed to be covered with delicate rays. On transferring some of the bodies to the field of the microscope, they proved to be giant specimens of the larger sun animalcule *Actinosphærium Eichhornii*. They measured from three fourths to one millimetre in diameter, independent of the rays, which extended from one fourth to half a millimetre more. One of the smaller individuals contained four water-fleas, Daphnias, a third of a millimetre long; and one of the larger contained six of these. The *Actinosphærium* appears to be tenacious of life, several specimens having been retained alive and in good condition for three days in a drop of water in an animalcule cage. They had discharged the Daphnias, but retained their original size. One of oval form measured 1 millim. long by 0·75 millim. broad. The smaller ones measured 0·75 millim. in diameter. After another day they appeared in good condition; but the rays were contracted so as to be about half the original length, and many had a minute granular ball at the end, apparently effete matter thrown off from them. At this time the animalcules were returned to the aquarium.—*Proc. Acad. Nat. Sci. Philad.*, Oct. 31, 1882, p. 260.

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XL.—*On the Affinities of the Genus* Pothocites, *Paterson; with the Description of a Specimen from Glencartholm, Eskdale.* By Robert Kidston, F.G.S.

[Plates IX.–XII.]

Introductory Remarks.

Last November I communicated to the 'Annals and Magazine of Natural History' a short note "On the Affinities of the Genus *Pothocites*, Paterson."

In this was included the description of a specimen, provisionally named *Pothocites calamitoides*, which was collected by Mr. T. Stock from the cement-stone group of the Calciferous Sandstone series, Glencartholm, Eskdale.

In the present paper it is my intention to illustrate and describe all the specimens of this genus which are known to me; the only one previously figured was that originally described by Dr. Paterson; but as there are a few points in his figure which are slightly misleading, I have thought it better to refigure *Pothocites Grantonii*, Paterson, along with the other specimens. This course is also advisable for the purpose of comparison.

The genus was founded by Dr. Paterson * for the reception of a curious fossil collected by him "in a mass of bituminous shale from the coal strata which are exposed along the coast at Granton, and nearly opposite Professor Hope's residence."

In discussing the probable affinities of his plant he says † :—"In taking a general view of this fossil, there are several living genera of plants to which it bears a resemblance, as *Typha*, *Calamus*, *Peperomia*, and *Pothos*. It will not be necessary to describe minutely the resemblance which it bears to either the *Calamus* or *Peperomia*, as it is distant, and does not stand minute examination. The first and last of these therefore, viz. the *Typha* and *Pothos*, it will only be necessary to enter into minute comparison with it.

"It approaches the genus *Typha* in having the reed-like stems, which terminate in a cylindrical head, and that head having one and occasionally two divisions. Although, however, this general description agrees, on more minute examination it will be obvious that it cannot be referred to the genus *Typha*. The pericarp in the genus *Typha* is surmounted with a feathery pappus, and has no scales surrounding the germen. Our fossil may have been a monœcious plant (the upper male part being wanting); but at all events it must have been a tetrandrous plant, from the remains of the four projections, which are represented in the magnified drawing. There is no appearance of there having been any pappus whatever, and therefore it is more likely to be referred to the genus *Pothos*. This class of plants, viz. the genus *Pothos*, is characterized by its spatha being monophyllous, spadix cylindrical, thickly set with flowers, perianth tetraphyllous, berry or capsule tetraspermous, the latter of which is occasionally terminated by four obtuse angles. They belong to the natural order *Aroideæ*. The characters of this class of plants will be found to apply very nearly to our present fossil, making allowance, of course, for the compression it has undergone, and the change of appearance produced by its mineralization.

"The greatest number of the species of the genus *Pothos* are parasitic, and inhabit the vast forests of tropical countries. In some of the species, also, there are truncated fleshy scales on each side of the germen, and which, in the young state, completely cover the male organs of the plant; these are especially conspicuous in *P. acaulis*. The similarity of the

* Paterson, "Description of *Pothocites Grantonii*, a new Fossil Vegetable from the Coal-Formation," Trans. Bot. Soc. Edinb. vol. i. p. 45, pl. iii. 1841.

† Paterson, "Description of *Pothocites*, &c.," *l. c.* p. 50.

habitats also favours the idea of it belonging to this class of plants.

Dr. Paterson, in an earlier part of his paper, expresses his opinion that his specimen belonged to the class of parasitic plants.

He also directs special attention "to a slight enlargement of the stem abruptly broken off, very similar, in fact, to what we see in twigs from which the leaves have fallen off, and is evidently to be referred to the remains of a deciduous leaf or spatha"*.

In regard to the *stellate bodies*, situated in longitudinal rows on the spike, he further says†, "When viewed with a lens, these small bodies are seen crowned with from four to five (generally four) ovoid and obtuse projections, with elevated edges; these assume a quadrangular appearance, and give the idea of a germen or capsule, crowned with four or five obtuse angles. The central depression, to which the flowering part of the plant had been attached, is also distinctly to be seen."

The view held by Dr. Paterson that this plant "either belonged to an extinct species of the genus *Pothos*, or to some extinct genus of plants very closely allied to it," was at the time supported by Mr. M'Nab, of the Botanic Gardens, Dr. Greville, and many other gentlemen.

Prof. Henslow, who also examined the specimen, thought it was probably related to *Potamogeton* or *Pothos*. He conceived that the spadix was continuous and not jointed, the apparent joints being the result of compression. He could not see any evidence of ribs, and was "unable to determine the exact nature of the quadrifarious arrangement, whether the parts are calyx-scales, or seed-valves"‡.

In the following description of this specimen some points will be noticed in which, I believe, Dr. Paterson has been deceived by certain appearances in his fossil.

This view as to the affinity of *Pothocites* has been accepted by Mr. Carruthers, Prof. Balfour, and others §.

Prof. Williamson, however, has expressed some doubt as to the systematic position of the plant. In a lecture on

* *L. c.* p. 46. † *Ibid.* ‡ *L. c.* p. 52, *note.*

§ Carruthers, "On Fossil Plants," delivered to the Geologists' Association as Presidential Address, Nov. 5, 1875; "The Testimony of Fossil Botany in reference to the Doctrine of Evolution," Presidential Address, delivered to the Geologists' Association, Nov. 3, 1876; "Notes on some Fossil Plants," Geol. Mag. vol. ix. 1872.

Balfour, 'Introduction to the Study of Palæontological Botany,' p. 66 (Edinb. 1872).

Geikie, 'Text-book of Geology,' p. 732 (1882).

"Primæval Vegetation in relation to Natural Selection and Evolution" he says, "It is also necessary to state fi[illegible] that the Coal-measures reveal some other remarkable stems, the exact relations of which are not yet fully ascertained.* Then in a footnote he adds, "This is especially in reference to the *Lyginodendra*, *Nœggerathiæ*, and to the curious *Pothocites Grantonii*, which latter is supposed by some botanists to be a monocotyledonous Angiosperm; this, however, appears doubtful. The genus *Antholithes*, from the Coal-measures, was regarded as a dicotyledonous Angiosperm allied to *Orobanche*; but this idea is now abandoned, and the plant is now referred to the group of Gymnospermous exogens. I expect that further research will lead to some similar change in regard to *Pothocites*" *.

Description of Specimens.

Pothocites Grantonii, Paterson. (Pl. IX. figs. 1–5.)

Pothocites Grantonii, Paterson, Trans. Bot. Soc. Edinb vol. i p. 45, pl. iii. (1841).

The full length of the specimen is rather less than $4\frac{3}{4}$ inches; of this the remains of the spike occupy $2\frac{4}{10}$ inches. This latter part consists of two complete segments and a portion of a third. Each internodal portion † of the fruit shows six longitudinal rows of *stellate bodies*, placed on slightly elevated ridges. It is difficult to determine definitely the original number of these vertical elevations, as the specimen is much compressed, and those towards the margins of the fruit are crushed together; but probably there were on the complete circumference ten such elevated ridges, bearing the stellate bodies; of course only five or six are exposed in the specimen. The two marginal rows are imperfectly shown; but the four on the now flattened, once circular surface are distinctly exhibited.

The *stellate bodies* are usually formed of four pointed projections, which radiate from a central depression; but in very rare cases they have five rays (Pl. IX. figs. 3 and 4).

In the enlarged view of these *stellate bodies* given at figure 3 on the plate which accompanies Dr. Paterson's description, the segments of the "quadrangular elevations" are represented as springing from a central tubercle; this is misleading, as no structure of this nature is shown on the fossil.

* W. C. Williamson, 'Essays and Addresses by Professors and Lecturers of Owen's College, Manchester,' p. 229. Macmillan, 1874.

† To the portions between the constrictions of the fruit I have applied the term internodal portions of fruit or spike.

In reality the segments conduct to a central depression. The appearance caused when these minute bodies are viewed with lateral illumination has probably led to this error in the figure. From Dr. Paterson's description it is evident that he recognized the true structure of these little stellate bodies; for he states, "The central depression to which the flowering part of the plant has been attached is also distinctly to be seen."

The appearance of a central column, as represented in his enlarged figure of the little stars, has probably been inadvertently indicated by the drawer of the specimen; but it has unfortunately been frequently copied without any explanation.

The internodal portions of the fruit bear about twelve of these *stellate bodies* on each longitudinal elevation.

I have given enlarged figures of two of these little *stars*, one composed of four, the other of five rays (Pl. IX. figs. 3 and 4).

I cannot distinguish any point to which the supposed "flowering part of the plant" could have been attached.

What appears as a border to the little stars is the upturned edges of the segments, which appear in section as represented at Pl. IX. fig. 5.

The lowest segment of the fruit is almost an inch long by five sixteenths broad, the second about seven eighths of an inch long and slightly narrower than the previous segment; and the third, which is imperfect, is slightly narrower than the second.

The stem to which the spike is attached is finely striated longitudinally.

The small projection from the side of the stem, about three-quarters of an inch below its junction with the fruit, is probably the remains of a branch which bore a similar spike (as will be shown in the description of the specimen from Barnton Pavement-stone Quarry), and does not represent the "remains of a deciduous leaf or spathe," as originally supposed.

The upper left-hand angle of the broken internodal portion is the most perfectly preserved; and it is his part which I have chosen for my enlarged drawing (Pl. IX. fig. 2).

The little "stars" are only shown on those parts of the specimen which have suffered least from pressure.

The specimen is deposited in the museum of the Royal Botanic Gardens, Edinburgh; and my thanks are due to the late Mr. Sadler, the curator, for permission to examine and refigure this interesting fossil.

Loc. From the Calciferous Sandstone series, shore, Granton.

The three following specimens have been already described by Mr. R. Etheridge, Jun.; but as they show some points of considerable value as regards the affinity of the genus *Pothocites*, I give a description of them here in full.

Pothocites Patersoni, R. Eth., Jun.
(Pl. X. figs. 6, 7, 8, Pl. XI. figs. 9 & 10, Pl. XII. fig. 14.)

Pothocites Patersoni, R. Etheridge, Jun., "Note on the Further Discovery of a Species of *Pothocites* (Paterson) in the Lower Carboniferous Rocks near West Calder," Trans. Bot. Soc. Edinb. vol. xii. p. 151 (1874).

Of this plant we have four specimens, representing two individuals. That figured on Pl. X. figs. 6 and 7, and Pl. XII. fig. 14, was obtained by Mr. James Bennie, fossil-collector to the Geological Survey of Scotland, from the black bituminous shale which overlies the oil-shale worked at Raeburn's Pit, near Gunn's Green Toll-bar, about a mile and a quarter north of West Calder.

The specimen, which is represented by the fossil (fig. 6) and the impression (fig. 7), measures in its full length three inches and three quarters. Four segments of this spike are shown; but it is imperfect towards its upper extremity.

This is proved by the central axis extending slightly past the last segment which has been preserved.

From the proportion which the uppermost segment bears to the other segments of the fruit it is probable that there originally were not more than two additional parts in the entire spike.

Of the whole length of the specimen the spike occupies about two inches and three fifths. The basal segment measures four fifths of an inch in length by three eighths of an inch in breadth. The segments decrease slightly in length and breadth as we recede from the base, the fourth being only seven sixteenths of an inch long and a quarter of an inch broad at its base; but it is somewhat narrowed at its apex. This narrowing of the segments at their apices, as will be shown in a specimen presently to be described, is only exhibited in the terminal portions of the fruit; the breadth of the lower segments in all the specimens is almost uniform throughout their entire length.

From the amount of pressure to which this specimen has been subjected, it is a matter of considerable difficulty to determine accurately the number of the longitudinal elevated ridges on each segment; but they appear to have had on their exposed surfaces six such rows, which run continuously through all the segments.

Towards the outer margins of the spike these only appear as dentate longitudinal lines.

Only the two lower segments show the cast of the original plant *in situ* (fig. 6); and although it has suffered much from compression, it stands out in considerable relief. The outer surface is also badly preserved; but still it shows what appear to be the same peculiar *stellate bodies*, so well shown on *Pothocites Grantonii.*

These do not seem to have been observed by Mr. Etheridge; but it is only on a small portion of the specimen, towards the right-hand margin of the basal segment, that they can be deciphered. They are so small that very favourable illumination is necessary for their detection.

The spike, as shown by the impression and the cast, has the general appearance of the longitudinal ridges being crossed by transverse bars, as mentioned by Mr. Etheridge.

The stellate bodies are situated at the extremities of these cross markings, which are connecting-ridges.

From the imperfect preservation of the little "stars," the transverse bars form a more prominent characteristic on this fossil than they do in better-preserved examples.

The little branch to which the spike is attached measures one inch and a fifth in length, and shows two swollen nodes.

The second internode is slightly larger than that next to the fruit. The presence of distinctly marked nodes and internodes, which are even better shown in two of the following specimens than in this one, throws great light on the systematic position of these fossil plants.

Mr. Etheridge, in his description of this specimen, says "that the longitudinal divisions of the cylindrical head were apparently crossed by transverse ridges, which may perhaps be caused by imperfect preservation or some peculiar state of the scattered rounded or quadrangular bodies mentioned by Dr. Paterson."

My examination of this example quite corroborates Mr. Etheridge's views in regard to these surface-markings.

The true nature of these bar-like markings is much better indicated in the Eskdale plant, where they are shown to be merely elevated ridges, extending from one sporangium to another.

Pothocites Patersoni, R. Eth., Jun. *
(Pl. XI. figs. 9 and 10.)

This example is preserved in a similar shale to the previous

* *L. c.* Trans. Bot. Soc. Edinb. vol. xii. p. 151.

specimen, and was also collected by Mr. Bennie from the Calciferous Sandstones at Fell's Pit, near the north-west corner of Briestonhill Moss, about three quarters of a mile north of West Calder.

The cast and impression of this specimen have also been secured. The fossil measures nearly four inches in length; but the spike is very imperfect, and only shows the lowest and a very small fragment of the second segment, which together occupy an inch.

The cast only shows the lowest segment, whose external surface is unfortunately very indifferently preserved; but it still retains a considerable amount of rotundity.

Notwithstanding the unsatisfactory state of its preservation, there are distinct indications of the quadrate bodies. These can be most easily examined by making a wax cast of the impression of the spike.

The lowest segment is nine tenths of an inch long; the sides are straight; the breadth, which is equal throughout, is three tenths of an inch.

The little branch to which the fruit is attached is two inches and three quarters long, very slender, and shows three swollen nodes; this in turn springs from a stouter stem, one inch and three quarters long, which is faintly striated longitudinally and also shows two nodes, from the lower of which the fruiting-branch springs.

On the same slab is the impression of another noded stem (not shown in the figure), whose length is one inch and three quarters, and breadth a little more than the fifth of an inch.

As it is not organically connected with the *Pothocites*, no direct evidence can be drawn from it. Its character, however, is identical with that of the branch to which the fruit is attached; and their association is not without significance.

On the cast of the specimen, where the details of the remaining segment of the spike are best preserved there appear to be four longitudinal rows of little pits, which, of course, on the plant must have been elevations.

Pothocites, sp. (Pl. X. fig. 8.)

Pothocites, sp., R. Etheridge, Jun., "On a new Locality for *Pothocites* (Paterson)," Trans. Bot. Soc. Edinb. vol. xii. p. 162 (1874).

This specimen exhibits little more than a carbonaceous stain on the stone, but is of great interest as being the only one, as far as I am aware, which shows two spikes terminating the extremities of a dichotomous branch. The impression of the plant is about three inches and a quarter long, the stem

occupying about two inches; each of the forks of the dichotomy measures about an inch. The spikes show imperfect longitudinal rows of little tubercular depressions and the usual constrictions which divide the fruit into segments.

We have seen from the description of the previous specimen that the branch bearing the spike arose from another similar but slightly larger stalk. This alone might have given us some insight into the nature of the small projection from the side of the stem of *Pothocites Grantonii*; but in this example its true nature is very clearly explained.

It would appear, then, that there is the greatest probability, if not positive certainty, that the little projection from the side of the stem of *P. Grantonii* is the remains of a branch which bore a similar spike to the one which has been preserved.

From the evidence adduced from this and the last-described specimen, it seems quite impossible to hold any longer the view so often expressed, that the "little projection" is evidently to be referred to the remains of a deciduous leaf or spathe *.

This specimen is also of Calciferous-Sandstone age, and was collected by Mr. James Bennie at Barnton Pavement-stone Quarry, Corstorphine Hill, near Edinburgh.

Pothocites calamitoides, Kidst. (Pl. XII. figs. 13, 15, 16, 17.)

Pothocites calamitoides, Kidston, "On the Affinities of the Genus *Pothocites* (Paterson)," Ann. & Mag. Nat. Hist. Nov. 1882.

This example was collected by Mr. T. Stock from the Cement-stone group of the Calciferous-Sandstone series, Glencartholm, Eskdale.

It is fully seven inches long; of this the spike occupies a little less than five inches and a half, and is, so far as is known to me, the first specimen in which the fruit is shown up to its extremity.

The spike contains eight segments, of which the three basal are about the same size and measure four fifths of an inch long by half an inch broad; the fourth and fifth segments (counting from the base upwards) are about equal to each other in size, but slightly less than those below them. They measure about seven tenths of an inch in length, and are slightly less than half an inch broad.

The succeeding segments decrease in size, the terminal one being only three tenths of an inch long. The upper extremities of the last three segments, but especially of the last two, are narrower than their basal portions; and in the apical one

* Paterson, *l. c.* p. 46.

this is very marked, causing it to have a truncated triangular outline.

The general contour of the other segments is quadrate; their sides are parallel; but the constrictions of the spike at the nodal regions cause a rounding of their angles.

The circumference of each segment has had about fourteen longitudinal rows of sporangia. On the surface exhibited on the fossil four rows are seen to occupy the greater portion of each segment; but on each side, one, or perhaps two, additional longitudinal rows of sporangia are exhibited. These, on account of the flattening of a once circular structure, appear now merely as longitudinal lateral ridges.

The sporangial ridges run continuously throughout the whole length of the spike, and do not alternate at the nodes.

On the upper segments of the spike these longitudinal elevations bear little quadrate protuberances with rounded angles and slightly notched sides (Pl. XII. fig. 16). Their outline is ill defined.

On the basal and older segment a few of the characteristic *stellate bodies* are shown. These are not so clearly seen as in *Pothocites Grantonii*, but are quite discernible (Pl. XII. fig. 17).

They are of about the same size as the quadrate bodies mentioned as occurring on the upper segments.

From this similarity in size it would appear that the *stellate bodies* are formed by the *quadrate protuberances* splitting in lines running from their centre to the apices of their rounded angles; and the four segments so divided subsequently become deflexed.

From the facility with which one can trace the development of the *stellate bodies* on this specimen, I am forced to the conclusion that the so-called "four-cleft calyx" is merely the deflected segments of sporangia which have shed their spores.

The sporangia connecting elevated transverse ridges, to which reference has been already made, are very well shown on this example.

The outer surface of the quadrate protuberances is roughened by slightly elongated apiculi.

The stem to which the fruit is attached shows three swollen nodes and is faintly striated longitudinally.

Its upper internode is very short, and measures only three tenths of an inch in length and a little less than two tenths of an inch in breadth. The internode immediately below it measures fully half an inch in length, whilst the lowest is four fifths of an inch long. The fourth internode is incomplete. The stem increases slightly in breadth from above downwards.

One of the most interesting points shown on this specimen is the verticils of leaves which are given off from the nodal regions of both spike and stem. This is shown more or less distinctly at all the nodes of stem and spike except at the lowest node of the stem, where a verticil of tubercles marks the site of the leaves which have fallen off.

The remains of the largest leaf measure half an inch; but more important is their dichotomous structure as exhibited by the leaves at the fourth, fifth, and sixth nodes of the fruit, counting from the apex.

This specimen was presented by Mr. Stock to Mr. John Young, Curator of the Hunterian Museum, Glasgow University. My thanks are due to both of these gentlemen for allowing me to examine and describe this beautiful specimen.

I am also indebted to Prof. A. Geikie, Director-General of the Geological Survey of Great Britain, for kindly allowing me the use of the specimens in the Geological Survey collection while preparing these notes.

From the examination of these five specimens of *Pothocites* it is shown that the plant possessed a segmented fructifying spike or cone. In the only perfect specimen the fruit consists of eight segments. The segments are formed by a constriction which corresponds in position to the nodes of the axis. On the circumference of each internodal portion of the fruit there have been from ten to fourteen longitudinal elevations which bore sporangia; these in the young state appear externally as quadrate bodies, having their angles rounded and a shallow notch on each side. The sporangia open in a definite manner, by a cleft passing from the apices of the angled corners towards their centre; and by the margins of the split sporangia becoming deflexed the so-called calyx-segments are formed.

The spike is also attached to a stem composed of nodes and internodes, which branched in a more or less equal dichotomous manner, and bore, at the extremities of the dichotomous branches, cones or spikes.

The stem also shows traces of longitudinal furrows.

Verticillate dichotomously formed leaves are given off from the nodes of both spike and stem.

From such important structural evidence it appears no longer possible to regard *Pothocites* as a Monocotyledon, and I am inevitably led to the conclusion that *Pothocites* is not the inflorescence of an Aroid, but the fructification of a Calamitaceous plant.

But from the material before us we can, I think, place the genus *Pothocites* in a much more defined systematic position

than merely indicate its nature to have been that of a Calamitaceous plant.

The characters by which we are enabled to show its more particular affinity are the leaves, fruit, and stem.

The foliage is distinctly dichotomous in its structure, as seen in the example from Eskdale.

The furrows on the stem are too indistinct to show whether or not they alternate at the nodes*.

The segments composing the fruit must, however, be regarded as the homologues of the internodes of the stem, so, in all likelihood, the longitudinal ridges of the segments of the fruit represent the furrows of the stem.

In the spike we see that the longitudinal rows of sporangia do not alternate at the nodes, but pass continuously throughout the whole fruit.

In the genus *Bornia*, F. A. Röm. (*Archæocalamites*, Stur), the furrows on the stem do not alternate at the nodes as in ordinary Calamites; and this well-marked character, possessed by no other carboniferous fossil plant, so far as I am aware, gives it an individuality which cannot be mistaken. Likewise in *Pothocites* we find that the longitudinal elevations which bear sporangia do not alternate at the nodes, but pass continuously throughout the whole length of the spike; and these ridges, I believe, are simply a modification of the furrows of the stem.

In the genus *Calamites*, where the furrows on the stem alternate at the nodes, we have no reason to suppose that this character would alter, even were they known to produce a *Pothocites*-like cone. But the fruit of the *Calamites* is well known; and whatever specific differences there may be in the described genera and species of their fructification, they are always of the *Volkmannia* type; hence it is not at all probable that *Pothocites* belongs to this group of the Calamiteæ.

The dichotomous nature of the foliage is not, however, restricted to the genus *Bornia*.

* It is an unsettled point amongst vegetable palæontologists whether the stems of *Calamites*, in their natural condition, possessed a smooth or a furrowed bark. Some contend that the outer surface of the stem was longitudinally furrowed, others that it was quite smooth, and that the furrows have been imparted by external pressure, or even that the fluted casts, which are of so common occurrence, are merely the internal casts of the hollow stems. But it is generally admitted that when *Calamites* occur as mere casts or impressions they almost invariably show a fluted exterior. Hence, in dealing with fossils in this condition (a condition in which all the specimens mentioned in these notes occur), the furrowing of the stem becomes of generic value, whatever structure the outer surface of the stems may have had when growing.

Stur has described a small *Sphenophyllum* (*S. tenerrimum*, Ett. MS.*) which also possesses dichotomously divided leaves. But this is easily distinguished from *Bornia radiata*, Brongn., by the leaves being much smaller and less regularly dichotomous. The fruit of this plant has also been described by Stur, and consists of a small *Volkmannia*-like cone.

Even on young branches of *Bornia radiata* the foliage is of considerable size. In the *Pothocites* from Eskdale (Pl. XII. fig. 13) we have apparently only the remains of the leaves, little more, indeed, than to show that leaves were given off from the nodal regions of the spike and stem.

For the purpose of comparison I have given three figures of *Sphenophyllum tenerrimum*, Ett. MS. (Pl. XI. figs. 11, 12, and Pl. XII. fig. 18); and as I have been unable to secure good specimens of foliage-branches of *Bornia* (*Archæocalamites*) *radiata*, Brongn., I give a copy of a figure by Feistmantel (see p. 310), which shows both foliage and the fragmentary remains of an undoubted fruit of *Bornia radiata*. This specimen was originally described under the name of *Asterophyllites spaniophyllus*, Feistm.†

Stur figures two other specimens of fruiting branches of *Bornia* (*Archæocalamites*) *radiata*, Brongn.

Both of these are very imperfect, and can only be fully understood from an examination of more perfect specimens.

That on pl. iii. fig. 5‡ represents a *Pothocites* in a very young state: two entire segments of the fruit are shown; but the upper part is hidden by a tuft of leaves.

The foliage arising from the nodal regions of the two segments shows very beautifully its full size and structure. That figured by the same author (pl. iv. fig. 9) is so imperfect that it gives no insight into the nature of the fruit.

To explain more fully the structure of the fruit of *Bornia radiata*, Stur gives two figures (enlarged two diameters) of the fragment of the spike on Feistmantel's original specimen (see p. 311) §.

His latter figure is a corrected drawing of the former; hence with it only we have to deal.

It is so very imperfectly preserved that the original describer remarked regarding it, "a cone-like structure is attached to

* Stur, Culm-Flora, pl. vii. p. 214.

† Feistmantel, O. "Das Kohlenkalkvorkommen bei Rothwaltersdorf in der Grafschaft Glatz und dessen organische Einschlüsse," Zeitschr. d. deutschen geol. Gesellsch. vol. xxv. pl. xiv. fig. 5, p. 498 (1873).

‡ Stur, Culm-Flora, Band i. p. 15, fig. 4, Band ii. p. (23) 129, fig. 9 (1875–7).

§ Stur, *l. c.*

the upper end of the present example, which may perhaps belong to it as a fructification; but, owing to its indistinctness, a closer investigation is impracticable"*.

Stur gives a very full description of his figure of this fragmentary cone of *B. radiata*, of which the following abstract contains the principal points which demand our attention:—

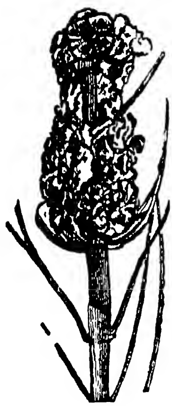
At the base of the spike the remains of a whorl of leaves are shown; in the whorl of leaves immediately below this; one of the leaves reveals its characteristic dichotomous structure. In the middle of the preserved portion of the cone, the presence of a second leaf-whorl is indicated by a single leaf. At the upper part of the cone portion is a "*receptaculum*," so exposed that one is enabled to see its outer surface. He further states that this "*receptaculum*" appears as if "divided into four slightly elevated lappets;" and he supposes that each of the "lappets" corresponds to the position of a sporangium attached below.

Branch of *Bornia radiata*, Brongn. (*Asterophyllites spaniophyllus*, Feistm.), showing fragment of a fruit and foliage. (Copied from Feistmantel, *l. c.*)

* Feistmantel, *l. c.* p. 498.

The upper surface of this "*receptaculum*" is unevenly rough. He further points out that the four "lappets" of the shield are only indistinctly separated from each other, being isolated only at the outer edge, but towards their inner grown together. Their dividing line is indicated by a shallow radial furrow; this, he thinks, may perhaps mark the point of the attachment of the "shield" to a stalk.

Stur also thought it very probable that four sporangia hung from the inner surface of the shield, and that, in consequence of pressure, their presence had caused the four slight elevations or "lappets" on the upper surface.



Fruit of *Bornia* (*Archæocalamites*) *radiata*, Brongn. (From Stur's 'Culm-Flora,' p. 120.)

According to this view, he thought it highly probable that the fruit of *Bornia* included several internodes, and that on the axis, between the leaf-whorls, several whorls of "*receptacula*" were borne; these consisted of a stalked, slightly lappeted shield, bearing on its inner surface four or five sporangia. He also believed the sporangia were (in opposition to recent *Equisetum*) elliptical, flattened, and granulated, about 1·4 millim. long by 0·6 millim. broad. One of the sporangia showed a beak-like projection at one end, which he thought indicated its point of attachment. He goes on to state that the stem, a small portion of which was exposed in the cone, was not jointed.

There are several points in this description which agree entirely with the Scotch specimens. Stur appears, however, to have been misled in some particulars by the imperfection of the example on which his opinions were founded.

We see here again, as in the other figures of this author already cited, the division of the fruit into segments.

The leaf indicating the nodal region, to which reference has already been made, springs from a point a little lower down the axis than the part where the axis is exposed; hence the node is not seen. In plants of this class the presence of a leaf indicates the presence of a node.

In the Eskdale plant this is clearly shown; but one of Stur's figures also shows the same character*.

But the most important structural point of agreement be-

* *Loc. cit.* pl. iii. fig. 5.

tween the Scotch specimens and the plant he so fully describes is afforded by the "*receptaculum*," which he says is "divided into four slightly elevated lappets," with an unevenly roughened surface.

This agrees in every respect with those shown on the upper portion of the *Pothocites* from Eskdale (Pl. XII. fig. 16). Their size also is almost similar.

Whether each of the lobes of the little quadrate bodies represents a sporangium, or the sporangium is four-lobed, I have not sufficient evidence to decide. It is quite possible that the sporangia were arranged in groups of four. It is, however, evident that the "stellate bodies" are formed by an outward radial splitting of the four lappets, the split edges of which eventually become deflexed.

The shield-like structure (quadrate bodies) of Stur is formed by the sporangia (or sporangium), and does not appear to be a peltate expansion to which they were attached as he supposes.

As already indicated, the sporangia are located on elevated longitudinal rows, which I regard as the equivalents of the furrows on the stem. But it must also be noted that the sporangia of contiguous rows stand opposite to each other.

From this comparison of the structure of the fruit, foliage, and stem of *Pothocites* with undoubted fruiting specimens of *Bornia radiata*, their agreement is so complete that it appears to me this genus can only be regarded as the fruit of *Bornia* (*Archæocalamites*) *radiata*, Brongn., or of a closely allied species of the same genus.

In the short description which I originally gave of the specimen collected by Mr. T. Stock at Glencartholm, it was provisionally named *Pothocites calamitoides*. I have since compared it carefully with the original type, and now find that the points I regarded as of specific value cannot be retained as such.

The chief character which induced me to bestow a specific name upon this specimen was the much greater breadth of the segments in proportion to their length, when compared with *Pothocites Grantonii*.

But this diversity is fully explained when we take into consideration the different states of development in which the two specimens occur.

In *P. Grantonii* the fruit appears to have passed maturity and shed all its spores, as indicated by the split sporangia, whereas in the Glencartholm example the lowest segment alone appears to have attained to this degree of ripeness, as only on it the "stellate" sporangia are shown.

In the course of development, we have every reason to believe that during the maturation of the spike the internodes would become elongated; so probably this difference in general outline is only indicative of a different state of development. It agrees with *Pothocites Grantonii* in all other respects.

The absence of nodes on the stem of *P. Grantonii* seems to be entirely due to changes it has undergone during mineralization. The specimen from Barnton Pavement-stone Quarry has also no indication of nodes on the stem; but, from the evidence afforded by the other specimens, there can remain little doubt as to both it and *P. Grantonii* having originally possessed stems similar in this respect to the other examples.

In regard to *Pothocites Patersoni*, Eth., the chief characters on which this species was founded consisted in the absence of the stellate sporangia and the presence of the "transverse bars." I have already mentioned that there are distinct indications of the stellate-like sporangia, and that the degree of prominence of the transverse bars depends greatly on the physical conditions under which mineralization has taken place.

In the plant I provisionally named *Pothocites calamitoides* the transverse bars are very distinctly seen, and associated with them we have the stellate sporangia placed upon their little knob-like extremities.

For these reasons, as well as the evidence afforded by the detailed descriptions of the various specimens, I believe that all these fossils are to be referred to *Pothocites Grantonii*, Paterson, and, further, that this plant is not a distinct and separate species, but the fructification of a species of *Bornia*, Röm., probably of *Bornia radiata*, Brongn. sp.

EXPLANATION OF THE PLATES.

Plate IX.

Fig. 1. Fruit of *Bornia radiata*, Brongn. (*Pothocites Grantonii*, Paterson). The fruit shows two perfect segments and a portion of a third. Each segment has several longitudinal ridges bearing sporangia which have opened. (Nat. size.) From the Calciferous Sandstone series, shore, at Granton.

Fig. 2. Portion of the uppermost segment of the same specimen, showing the arrangement of the sporangia. (Magnified.)

Fig. 3. An open sporangium composed of five rays, from the same specimen. (Magnified.)

Fig. 4. Another sporangium, with four rays. (Magnified.)

Fig. 5. Diagrammatic section (at right angles to the surface) of one of the rays on *Pothocites Grantonii*, Pat., showing that the apparent "*border*" to the rays is caused by an upward turning of their margins.

PLATE X.

Fig. 6. Fruit of *Bornia radiata*, Brongn. (*Pothocites Patersoni*, Eth.), showing the fruit attached to a calamitic stem. The spike shows three segments and a portion of a fourth. From the Calciferous Sandstone series, Raeburn's Pit, near West Calder.

Fig. 7. Impression of the same specimen, which shows more distinctly the transverse bars on the segments of the fruit. This example is imperfect, as indicated by a small portion of the axis extending beyond the uppermost segment preserved in the fossil.

Fig. 8. Fruit of *Bornia radiata*, Brongn., showing two spikes terminating the extremities of a dichotomous branch. From the Calciferous Sandstone series, Barton Pavement-stone Quarry, Corstorphine Hill, near Edinburgh.

PLATE XI.

Fig. 9. Fruit of *Bornia radiata*, Brongn. (*Pothocites Patersoni*, Eth.), showing the lowest segment. The fruit is attached to a stem composed of swollen nodes and internodes. The fruit-bearing branch springs from another similar but slightly stouter stem. (Nat. size.) From the Calciferous Sandstones, Fell's Pit, near West Calder.

Fig. 10. The impression of the last specimen. (Nat. size.)

Fig. 11. *Sphenophyllum tenerrimum* (Ett. MS.), Stur. From the Calciferous Sandstone series, Raw Camps, East Calder.

Fig. 12. The same. From the Calciferous Sandstone series, Burdiehouse. (In the Hugh Miller collection, Museum of Science and Art, Edinburgh. My thanks are due to Prof. Archer for permission to figure this specimen.)

PLATE XII.

Fig. 13. Fruit of *Bornia radiata*, Brongn. (*Pothocites calamitoides*, Kidst.), showing a perfect spike composed of eight segments attached to a calamitic stem. Leaves are given off from the nodal regions of both stem and fruit, some of which show the dichotomous nature of the foliage. From the Calciferous Sandstone series, Glencartholm, Eskdale.

Fig. 14. *Bornia radiata*, Brongn. Enlarged sketch of the impression of the basal portion of the fruit of the specimen from Raeburn's Pit, West Calder, showing transverse bars and node on stem.

Fig. 15. Lowest node of the stem of the Eskdale specimen, showing scars from which leaves have fallen. (Enlarged.)

Fig. 16. Two unopened sporangia, from an upper segment of the spike of the same specimen. (Enlarged.)

Fig. 17. One of the open (stellate) sporangia, from the lowest segment of the same example. (Enlarged.)

Fig. 18. *Sphenophyllum tenerrimum* (Ett. MS.), Stur. From the Calciferous Sandstone series, Raw Camps, East Calder.

Figs. 6–11, 14, and 18 are from specimens in the collection of the Geological Survey of Scotland, Edinburgh.

XLI.—*Investigations upon some Protozoa.* By Dr. August Gruber.

[Plate XIII.]

[Continued from p. 276.]

II. On some Infusoria.

1. *Spongomonas guttula.*

In his comprehensive and exceedingly meritorious general work upon all the known Infusoria, Saville Kent* has made known a new species of the genus *Spongomonas*, which is chiefly distinguished by the circumstance that it constructs larger sac-like colonies. In a small aquarium, in which the water had been putrid for some time, I accidentally found a large quantity of brownish spheres, which, on closer examination, also proved to be produced by small Flagellata.

The colonies of *Spongomonas guttula*, as I shall name the Infusorium, are vesicles, either quite spherical or folded by the falling-in of the surface, which adhered partly to the walls of the glass, partly to all sorts of objects contained in it, and in part also hung from the surface of the water.

At the side by which they are attached there is an aperture through which we can see into the interior of the hollow ball. Their size was very various; but I have never found one larger than that represented of the natural size in fig. 8.

As in Kent's *Spongomonas sacculus*, the brown colour is due to small granules, which, held together by gelatinous matter, form the principal mass of the colony. The individual Infusoria are not irregularly distributed over the surface of the ball, but planted at regular distances in the jelly.

Each of the minute Flagellata is placed at the end of a tube which it has itself secreted. These tubes, however, are not separated from each other, but firmly amalgamated together, as in the gelatinous spheres of the Ophrydinæ. These canals are most distinctly seen at that part of the vesicle where the aperture is situated; for there we may trace them throughout their whole length. In proportion as they become longer the whole vesicle also increases in dimensions.

The origin of these colonies is not easy to explain; and it seems to me the most probable supposition that the Flagellata dispersed in great quantities through the water, settled upon air-vesicles which adhered to the walls of the aquarium or floated at the surface of the water. In somewhat putrid

* 'A Manual of the Infusoria' (London, 1880-81), pp. 288, 289, pl. xii. figs. 17-23.

water such sources of oxygen will of course be preferently sought by the Infusoria. This would also explain why the colonies form hollow spheres. The Flagellata may have constructed their tubes from the periphery of the air-vesicle outwards, and subsequently the air in the interior may have disappeared. Besides the settlements constituted as above, there were also very frequently unions of only a very few individuals; and in these no indications of the tubes were to be observed.

The Infusoria themselves do not differ from the species allied to them. Generally the body, which measures 0·01–0·015 millim., is globular; but it may assume a more oval form. Imbedded in the granular protoplasm are the vacuoles and nucleus, which latter is not visible in the living animal, but becomes very distinct by staining with carmine solution. Lastly, at the anterior end of the body arise the flagella, two in number, as is the character of the genus *Spongomonas*.

2. *The Genus* Stichotricha.

While most of the hypotrichous Infusoria have not the habit of secreting a protective envelope around their bodies, we find in one genus of this section such a practice fully developed, namely in the genus *Stichotricha*. The other Hypotricha, indeed, can very well dispense with any protective arrangement, as they usually possess a firm, often carapace-like cortical layer; but this is not the case in *Stichotricha*, in which the body is extremely soft and flexible. Under the name of *Stichotricha socialis* I formerly made known a form* which constructs dendritically branched tubes, while Stein† has figured and described *Stichotricha secunda*, which is possibly only a variety of the above species, and which lives solitary, and constructs a somewhat flask-shaped carapace rounded at the bottom. I have since observed other forms of carapace- and colony-construction in *Stichotricha*; and these I would now describe.

I may remark that to two of these Infusoria I have not given new names, because I cannot say with certainty whether they are distinct species or only varieties of the same species. This applies especially to one form which was coloured green by the presence of chlorophyll-corpuscles‡. This *Sticho-*

* "Neue Infusorien," Zeitschr. fur wiss. Zool. xxxiii.

† Der Organismus der Infusionsthiere, Bd. i.

‡ I say chlorophyll-corpuscles without in any way wishing to decide whether we have to do here with true chlorophyll-corpuscles, or, according to Brandt and Entz (Biol. Centralbl. Bd. i. pp. 524 and 646), with unicellular Algæ.

tricha occurred in great abundance in a basin in my father's garden in Genoa, in which a number of green Flagellata were also living.

The colonies consisted of long repeatedly bifurcating filaments, which were sometimes attached to the bottom or the side walls of the vessel in which I kept the animals, and sometimes hung down from the surface of the water. These filaments themselves appeared to be coloured green by the innumerable *Stichotrichæ* which were seated upon them. In fig. 6 I have endeavoured to represent the end of such a filament magnified 40 diameters.

The filament itself consists of nothing but the gelatinous material of the numerous tubes which the *Stichotrichæ* have formed, and which have gradually become amalgamated into a common mass, to which quantities of all sorts of foreign bodies (Diatoms, fæces, and the like) have attached themselves. It shows the same analogy with the colony of a Flagellate Infusorian (*Spongomonas*) figured by Stein (Organismus d. Infusionsth. Bd. iii. i. Taf. vi. fig. 11) as the carapace of my *Stichotricha socialis* with those of other Flagellate Infusoria, e. g. *Rhipidodendron* and *Phalansterium*. The Infusoria are seated at the periphery of the filament or tube; and then we see that each of them inhabits a tube of its own, in which it slips to and fro. The tubes may often be pretty long; but they never ramify, which must be due to the fact that in the division of the *Stichotricha* one half emigrates and settles itself between the other Infusoria. The more the settlement takes place at the apex the longer does the filament become.

As regards the *Stichotricha* itself, it shows nothing at all remarkable, on which account I have not investigated it more particularly. The animal measured about 0·1 millim., and was distinguished from others of its genus only by the green corpuscles in the interior *.

A second variety of the genus *Stichotricha* I found in a small aquarium of the Zoological Institute here. While *Stichotricha secunda* produces regular tubes, *Stichotricha socialis* dendritically branched tubes, and the form just described filiform or cylindrical colonies, the last-mentioned Infusorian constructs irregular domiciles, usually hand-shaped, in which the individual tubes issue like fingers from a broad flat surface. Frequently, also, we find *Stichotrichæ* which do not live in societies, but in separate irregular tubes formed amongst all sorts of decomposed matters. The Infusorian

* I have a recollection of having found a notice somewhere of a green variety of *Stichotricha*; but unfortunately I cannot cite the passage.

itself measures about 0·15 millim., or at least its larger forms, and has the same structure as the other *Stichotrichæ* referred to.

While hitherto only such representatives of the genus *Stichotricha* have been known as secrete domiciles consisting of a gelatinous material covered with granules of all kinds, one species, which I shall name *Stichotricha urnula*, behaves quite differently. It lives in a transparent membranous capsule of a flask-like shape, closed throughout except a narrow anterior opening (fig. 7), and scarcely ever quits it. The edges surrounding the aperture have a tendency to fall together when the Infusorian is entirely retracted within the carapace. The envelopes of *Stichotricha* differ from those of many peritrichous Infusoria (*e. g.* the *Cothurniæ*) in that they are not attached to any support; hence the bottom of the flask is completely rounded off. They have a greater resemblance to those capsules which many Heterotricha (such as the species of *Freia*) construct for themselves. The length of the capsule is about 0·07 millim. in the full-grown forms. The animal which dwells in this envelope differs notably from the previously mentioned species of *Stichotricha*, but, it seems to me, not sufficiently to necessitate the creation of a new genus for it.

The difference becomes especially perceptible when the Infusorian stretches the anterior or neck part far out of the carapace, in order to procure food by the action of its cilia (fig. 7). In this state the hinder part of the body is not pointed, as elsewhere in this genus, but rounded off in the form of a ball or club; *i. e.* it assumes exactly the form of the bottom of the flask, from which it is separated by a small interval. This thick part of the body then narrows suddenly to form the neck, which is protruded far out of the carapace, and bends towards one side, as is proper to all *Stichotrichæ*. It may also happen that nearly the whole animal is drawn out in length, by which means the neck acquires a still further extension. This shows how extraordinarily contractile the body-substance of *Stichotricha urnula* is. When the Infusorian retracts itself into the capsule it loses this peculiar form, and then exhibits the ordinary structure of an Oxytrichine.

The protoplasm of the body is very rich in granules and consequently opaque, so that I have never succeeded in detecting any thing of the nucleus in the living animal. By staining with carmine solution, however, it immediately appears distinctly. It consists of two bean-shaped bodies, such as are typical of the family. Very frequently both of them are not placed perpendicular to the longitudinal axis of the

animal, but one of them is placed horizontally. This is probably due to the fact that the hinder part of the body, having assumed the rounded form, has suffered a displacement of its inner parts. It is remarkable that I could not succeed in detecting the nucleoli.

The ciliation is that characteristic of the genus *Stichotricha*. I do not enter here into such details with regard to it as I have already done elsewhere*, but confine myself to describing the particularly prominent cilia. There are, in the first place, the three long, stout, somewhat curved cilia at the extreme summit of the neck, which are followed by the peristome with its regularly arranged row of cilia. At the posterior extremity of the peristome there is the fine membranous seam (see fig. 7) which is here much more distinct than in *Stichotricha socialis* for example. It stands much further out from the neck, and thus forms a sort of frill, such as has frequently been described in other Infusoria.

On the neck we see, further, the separate rigid setæ standing regularly wide apart, as in the other *Stichotrichæ*. Besides these, flexible cilia, arranged in rows, cover the body, although here, on account of the carapace, they are difficult to observe. They are most distinctly perceptible at the posterior end of the Infusorian, where they also present remarkable peculiarities. *Thus they can act alternately as cilia and as pseudopodia.* In the former capacity they move in the well-known manner, beating to and fro; in the latter they serve to attach the body to the carapace, to which they adhere like the pseudopodia of a monothalamous Rhizopod. The posterior end of the *Stichotricha* is, in this case, not rounded off, but drawn out into irregular lobes; and these conditions may follow one another alternately and quickly—a further proof of the analogy (in this case *identity*) of the cilia and pseudopodia.

Stichotricha, of course, propagates by division; and then for a time there are two individuals in the same capsule. One portion wanders forth and immediately secretes a new capsule, either at a distance from the original one, or, should circumstances be favourable, in its vicinity. In the latter way large aggregations of *Stichotrichæ* are gradually produced. The intertwined flaskets, from which the long necks of the Infusorians look forth, present a pretty appearance.

I found *Stichotricha urnula* at the surface of the water in a small glass vessel in which, for a particular purpose, I had mixed fresh water with artificial sea-water. The latter was obtained from our marine aquarium, the former from the spring-conduit; so that there can hardly be any doubt that the

* "Neue Infusorien," Zeitschr. für wiss. Zool. xxxiii.

Stichotricha had been introduced with the sea-water. On two occasions, also, I succeeded in detecting one of them in a sample from the aquarium. Evidently the conditions in the small vessel filled with brackish water were very favourable to the *Stichotrichæ*, as they had rapidly increased to a considerable extent.

Lastly, it still remains for me to say something about the resemblance which *Stichotricha urnula* has to the genus *Chætospira*. I have already * put forward the supposition that the *Chætospira* which Lachmann † has figured may be identical with *Stichotricha*. This has become to me a certainty since *Stichotricha urnula* came under my observation. A glance at Lachmann's figure 7 will show that the figure represents a form which is not to be distinguished from my *Stichotricha urnula*.

Recently Saville Kent, in his 'Manual of the Infusoria' (London, 1880 and 1881), has cited the genus *Chætospira* and figured a species of it (pl. xxix. figs. 37, 38). He also refers it to the Heterotrichous Infusoria—an error which is easily explained, as the numerous cilia of the rows running over the body often produce the impression that the Infusorian is entirely covered with cilia. I think, however, that I have sufficiently proved that this is not the case, and that the Infusorian possesses all the characters of an Oxytrichine, and particularly of a *Stichotricha*.

Although Lachmann's and Kent's figures scarcely leave any doubt that their species are the same as my *Stichotricha urnula*, I have preferred not to retain the name *Chætospira*, because this generic name has hitherto been applied among the Heterotrichous forms. Moreover it seems to me, as already stated, justifiable to refer the Infusorian to the previously existing genus *Stichotricha*.

In conclusion, I must call attention to an Infusorian, to which its discoverer, Hudson ‡, has given the name of *Archimedea remex*, whilst he appends the designation *Chætospira* in brackets with a note of interrogation. Kent (*loc. cit.* p. 603) quite correctly regards this form as a *Stichotricha*; and as the domicile differs essentially from those of allied species, it must be named *Stichotricha remex* §.

* "Neue Infusorien," *loc. cit.*

† "Ueber die Organisation der Infusorien &c.," Muller's Archiv, 1856, Taf. xiii. figs. 6, 7.

‡ Monthly Micr. Journ. vol. xiv. p. 165.

§ The last part of Kent's 'Manual' only reached me after this memoir had been sent to the editors. In it the above-mentioned form is also cited as *Stichotricha remex*; but, on the other hand, a new genus, *Schizosiphon*, is created for my *Stichotricha socialis*, which seems to me not to be necessary.

III. On Processes of Fusion in *Actinophrys sol* *.

It is well known, as a phenomenon frequently observed and described, that an intimate union of two or more individuals occurs among the Heliozoa. In this way regular syncytia may be produced, often consisting of more than twenty individuals. As regards the signification of this process, it appears to be certain that it stands in no relation to reproduction. The Heliozoa usually separate again without our being able to observe any alteration either in the nucleus or in the soft body. Hence it has been supposed that the sole purpose of these unions was to facilitate the reception of food, in favour of which we have also the circumstance that in this state the Heliozoa generally contain much nutritive material.

I have long had it in view to go carefully into this question, but could never obtain sufficient material. In this I only succeeded quite recently, when an abundance of *Actinophrys sol* had become developed in a small aquarium of the Institute here. Nevertheless I found it impossible to throw any more light by my investigations upon the significance of the colony-formation among the Heliozoa. But some other remarkable processes came under my observation, upon which I may report briefly. These are phenomena of fusion in which, in contrast to the formation of colonies, the two parts passed completely into each other (that is to say, one of them, namely the smaller one, was devoured by the other), and from which it appeared that separated fragments of *Actinophrys* or small individuals *without a nucleus* are able to perform their normal functions.

A full-grown normally formed *Actinophrys sol* had approached a much smaller specimen furnished with only a few pseudopodia, had been suddenly attacked by it, and in a short time passed entirely into it. After the union had become complete, so that the larger *Actinophrys* had again assumed its rounded form, I killed it with chromic acid, stained it with carmine, and mounted it in Canada balsam, when it appeared that only a single nucleus was to be seen in the centre of the Heliozoan. Hence I thought it must be supposed that the nuclei as well as the protoplasmic bodies of the two individuals had passed into each other.

To arrive at a certainty upon this point I endeavoured to observe the process again; and by shifting the covering-glass and drawing off and adding water under it, I succeeded in

* The essential parts of the following results have already been published in the 'Zoologische Anzeiger,' no. 118.

causing one of the numerous small *Actinophryes* present to approach a full-grown one in such a manner that it remained attached to its pseudopodia. Immediately it quickly approached the larger specimen or was drawn in by the latter; the pseudopodia partially fused together, and a bridge of protoplasm began to unite the two individuals (fig. 9). In about five minutes they were already for the most part fused together. At this moment the Heliozoa were killed as above described, stained, and mounted. During this it appeared that the smaller individual *had possessed no nucleus at all.* While in the larger *Actinophrys* the nucleus stands out from the surrounding protoplasm in the centre as distinctly as possible, no trace of any thing of the kind is to be recognized in the smaller one *. This explained why, in the previously cited process of fusion, only *one* nucleus was to be detected in the coalesced Heliozoa.

I have since frequently repeated this experiment, and always with the same result. I also succeeded in causing large *Actinophryes* furnished with nuclei to unite by bringing them artificially into contact. In this case, however, the union only took place slowly, while in the former it was rapidly effected; and although in the latter cases the outer contours did not indicate that two individuals were united, this could be clearly discerned from the two nuclei. Frequently the two approximated Heliozoa repulsed each other again—a proof that the union takes place consciously, if we may use such an expression. In favour of this we have also the circumstance that even the small individuals of *Actinophrys* are not always incepted. I once succeeded in conveying to a large specimen three small ones one after the other, all of which were absorbed by it, notwithstanding that several green food-particles were also received. I have represented the individual in question in fig. 10, and indeed at the moment when two of the small parts were almost amalgamated, while the third had already passed entirely into the protoplasm of the large *Actinophrys*, in which the above-mentioned green bodies were also imbedded. This individual now persistently refused to take up a fourth small Heliozoan which was brought close to it, always pushing the latter away from it, evidently because it was not disposed to undergo any further increase of substance.

It seems to me therefore that the observed processes have really no other signification in the case of *Actinophrys* than

* I may remark here that the difference of size between the coloured and living *Actinophryes* is always considerable, as the former are strongly contracted by the absolute alcohol.

an augmentation of substance, and that in this way the assumption that we have to do here with an act connected with reproduction, such as a conjugation, is completely excluded.

Perhaps, however, the fact that the above-mentioned small individuals (as I have called them) possess no nuclei is directly opposed to this view. This latter fact is remarkable enough; and I must enter upon it in further detail. The first question is, How are the organisms described by me as small individuals to be conceived? as perfect organisms or not?

To this it may be answered that they are nothing more than products of the disintegration of larger *Actinophryes*, and not the offspring of a Heliozoan by regular division. This may perhaps be quite correct; and a breaking-up into irregular fragments does occur here, and, as I intend hereafter to show, also among the higher Protozoa, namely the Infusoria. This, however, furnishes no reason why these disintegration-fragments should not in the present case be regarded as really individuals.

Thus, if we examine one of these so-called small *Actinophryes* more closely, we find that in truth it does not differ essentially from the perfect *Actinophryes*. At least there are specimens which are quite regularly formed; and, at all events, all of them are perfectly independent. Many certainly consist only of a few vacuoles surrounded by scanty protoplasm, from which one or two pseudopodia arise. But for the most part they were of an approximately round form. The vacuoles and protoplasm were distributed as in the full-grown animal; and numerous pseudopodia, often regularly arranged, radiated from the margin.

Further, the functions of these creatures are the same as those of the nucleated *Actinophryes*. They move spontaneously from place to place; they show rapid changes in the pseudopodia; in their interior we see nutritive bodies; and even the large vacuoles in which large food-particles are digested are frequently to be seen. Finally, very often the contractile vesicle is not wanting, and it pulsates rhythmically in the same way as in the normal animals. Must we not therefore designate these non-nucleated forms as independent individuals? It may be objected that even in the mode in which the fusion takes place the imperfect independence of the small parts is demonstrated, as they are actually swallowed just like other prey. But the latter statement is not quite correct; for, until it has entirely passed into the other, the small animal retains the faculty of extruding pseudopodia, and, further, two non-nucleated *Actinophryes* may approach each other and unite.

I first of all brought together two small animals, and observed that they attracted each other very quickly and fused into a single mass, which of course when prepared proved to be destitute of nucleus. Another time I brought about the union of two Heliozoa of unequal size, of which I regarded the smaller as non-nucleate, the larger as normal and nucleated; in both the vacuoles pulsated very distinctly. The fusion took place here exactly as in the case previously described. I waited until the small animal had passed entirely into the larger one and the latter had resumed the round form, and then stained it with carmine. To my astonishment no nucleus appeared; therefore even the larger of the two Heliozoa, which had all the characters of a normal individual, had also been without a nucleus. Illusion by insufficient action of the reagents cannot have occurred in this observation, seeing that other examples and all sorts of other Protozoa were lying together under the same glass cover, and in these the nuclei became intensely coloured. A further demonstration is furnished by another case, in which two *Actinophryes* of exactly similar form and with very abundant vacuoles had united and begun to fuse together; but I interrupted the further continuance of the process, and stained the mass when it had about assumed a biscuit-shape; and it turned out that only one of the animals possessed a nucleus, while no trace of one could be observed in the other.

From all this we may therefore assert the proposition that the absence of the nucleus in *Actinophrys* does not prevent the protoplasm from performing its functions in the normal fashion.

In the Monera, although they possess no nucleus, we are accustomed to see all vital phenomena pursue their course in the protoplasm; but among the Protozoa, in which the presence of a nucleus is normal, one might have expected from the latter a greater influence upon the protoplasm.

It follows from this, therefore, *that the nucleus has no importance for those functions of the cell-body which are not directly connected with reproduction—that is to say, movement* (pseudopodium-formation), *inception of food, excretion* (pulsation of the contractile vacuole), *and growth; it may also be without influence on the external form.*

As regards the fusion-process here noticed itself, I have already remarked that it can hardly have any other significance for the *Actinophrys* than that of an increase of substance by the inception of the non-nucleated individuals contained in the water—just as upon one cosmical body there fall the ruined fragments of another like it, which revolve in the cos-

mical space, if this comparison be permitted. And, indeed, they would seem to be ruined fragments with which we have here to do—that is to say, fragments of Heliozoa not produced by regular division, but by the breaking-up and repeated fission of normally formed individuals.

I shall perhaps hereafter have occasion to notice that such a breaking-up into small pieces is a very frequent if not even a regular periodical phenomenon among the Infusoria *; and this applies also, according to my observations, to *Actinophrys* among the Heliozoa. I have previously made the same observation, but without going further into it.

In the present case it would appear that these disintegration-fragments, which, as we have seen, may possess a high degree of individuality, do not perish, but gradually become converted into perfect *Actinophryes* or pass into the body-substance of others.

Unfortunately the difficulties in the treatment and preparation of these objects is too great to permit one to hope ever to arrive at perfect certainty about them, and to decide such a question as whether the non-nucleate individuals are able to produce a nucleus endogenously. It seems to me that this hypothesis is not to be absolutely rejected out of hand, especially in the case of a Heliozoan which is pretty nearly allied to those Rhizopoda in which the first nucleus must at some time have originated freely. We certainly can hardly give a satisfactory explanation of the breaking-up of the Heliozoa (unless we regard it as pathological), except that thereby a more rapid multiplication may be attained. The whole process has some resemblance to histolysis during the embryonic development of some of the higher animals. Just as in the latter process we see many layers of cells dissolve completely, to be afterwards built up again out of the ruins, so here unicellular organisms break up into small fragments, which again become formed into new individuals, partly by fusion with others and partly by their proper growth.

In conclusion, I must still mention that frequently the small non-nucleate elements, on coming into contact with the pseudopodia of the normal animals, suddenly burst asunder and break up into a mass of granules, which, however, are nevertheless incepted. In one case a small individual had approached an *Actinophrys*; and when it was involved in the pseudopodia of the latter, it broke up suddenly, so that nothing

* These investigations have not yet reached that completeness which would allow me to cite them here.

more than an irregular mass of granules was to be seen. These, however, were held together by the pseudopodia of the large individual; a capsule of protoplasm formed around the mass of ruins; and it was then gradually drawn into the body of the *Actinophrys*, into which it had soon completely passed.

EXPLANATION OF PLATE XIII.

(This plate contains only a selection from the numerous figures given by Dr. Gruber. His numbers are given in parentheses.)

Figs. 1–4. *Pachymyxa hystrix.*

Fig. 1 (1). A middle-sized *Pachymyxa* with extended pseudopodia, alive. We see the little bacilli of the envelope which give the Rhizopod a brown colour by transmitted light. Regularly distributed over the surface are the pores for the issue of the processes.

Fig. 2 (4). A living specimen which has rolled itself spirally in the middle part. Pseudopodia issue from the two extremities.

Fig. 3 (6). A small portion of the surface of a *Pachymyxa* killed with osmic acid and stained with picrocarmine. The protoplasm shows two layers—an inner lighter one, with granules and nucleiform bodies, and an outer hyaline deeply stained one, from which the pseudopodium issues.

Fig. 4 (7). The supposed naked variety of *Pachymyxa hystrix*. Two specimens fused together, living; the larger is absorbing the nutritive mass of the smaller one. The larger one is characterized by the sharp separation of an outer and an inner layer of protoplasm and by the regularity of the former. At the periphery pseudopodial cones with pseudopodia appear at uniform distances apart.

Fig. 5 (12). An *Amœba obtecta*, living, in its brownish envelope, from the orifice of which pseudopodia issue.

Fig 6 (17). *Stichotricha*, sp. The extremity of a filamentous colony with a great number of Infusoria which project from the gelatinous mass.

Fig. 7 (22). *Stichotricha urnula.* A specimen in its flask-shaped carapace, with the anterior part of the body prolonged into a neck. At the peristome the membranous seam is distinctly perceived.

Fig. 8 (31). A large vesicle of *Spongomonas guttula* of the natural size.

Fig. 9 (41 *b*). A large and a small *Actinophrys* artificially brought together, with the pseudopodia mingling. The union has commenced, a plasma-bridge extending between the two individuals.

Fig. 10 (42). An *Actinophrys* which has taken up three small individuals, two of which are still visible; besides these it has taken in some green food-particles.

XLII.—*On the Supposed Absence of Basals in the* Eugeniacrinidæ *and in certain other Neocrinoids.* By P. HERBERT CARPENTER, M.A., Assistant Master at Eton College.

ALTHOUGH it is well known that the basal plates are of fundamental importance in the morphology of a Crinoid, and are the earliest of the calyx-plates to appear in the larva, yet they are generally supposed to be absent in several members of the order. The oral plates, which appear, together with the basals, shortly after the conclusion of the gastrula-stage, do indeed entirely disappear in the full-grown *Pentacrinus* and *Bathycrinus* and in most *Comatulæ*; but this is not the case with the basals, either in these genera or in any other living Crinoid. Nevertheless it seems to be thought by some palæontologists either that certain Crinoids never had any basals at all, or else that the larval basals undergo a still more complete resorption than those of most recent *Comatulæ* do, and disappear altogether from the calyx of the adult. These plates, however, have such a very definite relation to important internal organs, that their total disappearance seems improbable, while there are some reasons for thinking that they are actually present and even well developed in various Crinoids which are supposed to be altogether without them.

According to Mons. de Loriol* the calyx of the Eugeniacrinidæ is composed of radials only, without any basals; and he considers the absence of basals to be an important character distinguishing this family from the Apiocrinidæ and Pentacrinidæ. Beyrich†, however, for reasons to be mentioned later, came to the conclusion that the basals of *Eugeniacrinus* are internal and situated within the ring of radials with which they are united; and Zittel‡ supposed, for the same reasons, that rudiments of basals which had perhaps been present in early life are to be found in the adult calyx, though enclosed by the upper part of the radials. De Loriol §, however, has been unable to detect any traces of such internal basals. Beyrich had previously pointed out that their presence would indicate an affinity between *Eugeniacrinus* and *Rhizocrinus*. The calyx of the latter genus, as described by Sars ||, consists

* Crinoïdes fossiles de la Suisse (Geneva, 1877-79), pp. 196, 197; and also Paléontologie Française: Terrain Jurassique, tome xi. pp. 74, 75.

† Zeitschr. d. deutsch. geol. Gesellsch. 1869, Bd. xxi. p. 835.

‡ Palæontologie, Bd. i. p. 385.

§ Paléontologie Française, *loc. cit.* p. 77.

|| Mémoires pour servir à la connaissance des Crinoïdes vivants (Christiania, 1868), p. 12.

of five closely united radials resting on an enlarged top stem-joint and enclosing a kind of basal rosette, like that of *Antedon*.

Pourtalès, however, who had studied examples of *Rhizocrinus lofotensis* from the Gulf-stream, described the radials as resting upon five elongated basals, the sutures between which could only be seen with difficulty. But when the calyx was forcibly split open, "the fractures followed the joints between contiguous basals, and between the latter and the first radials" *. Pourtalès further described another species of *Rhizocrinus* (*R. Rawsoni*), in which the interbasal sutures are quite as distinct as those between the radials. Nevertheless these facts were quite overlooked by Ludwig †, though he quoted Pourtalès's memoir. But, while retaining Sars's views as to the subradial portion of the calyx being the top stem-joint, he gave another and more correct interpretation of the calcareous plate which Sars called the basal rosette; and instead of adopting Pourtalès's analysis of the calyx, he described as a basal ring a portion of the upper surface of the calyx immediately surrounding the so-called "rosette" of Sars. This supposed basal ring, however, is really the interior of the widely open central funnel of the calyx, and is formed by the united ventral faces of the radials; while what Ludwig took for radial sutures separating the basals are really nothing but the ventral furrows of the radials, which lead downwards into the intermuscular furrows of their distal articular faces.

Thus, then, we may regard Pourtalès as having proved that in the recent species of *Rhizocrinus* the calyx consists of basals and radials, just as in *Apiocrinus* and *Bourgueticrinus*, though the sutures between the plates are not always visible. Zittel ‡ has shown the same to be the case in the fossil species. In the Caribbean variety of *R. lofotensis* the interbasal sutures are generally visible externally; but in the European variety this is not the case, and sections through the decalcified calyx do not reveal their presence, so that the anchylosis of the plates must be very close. Similar variations appear in the allied genus *Bathycrinus*. In describing *B. gracilis* Sir Wyville Thomson § spoke of the lower portion of the head as

* "Contributions to the Fauna of the Gulf-stream at Great Depths," Bull. Mus. Comp. Zool. vol. i. no. 7, pp. 128–130; and "Zoological Results of the Hassler Expedition," Ill. Cat. Mus. Comp. Zool. no. viii. pp. 28, 29.

† Morphologische Studien an Echinodermen, Band i. pp. 120–122.

‡ *Loc. cit.* pp. 392, 393.

§ "On the Crinoids of the 'Porcupine' Deep-Sea Dredging Expedition," Proc. Roy. Soc. Ed. vol. vii. (1869–72) p. 772.

consisting of a "gradually expanding funnel-shaped piece, which seems to be composed of coalesced upper stem-joints." But the cup of *B. Aldrichianus* was described by him * as consisting "of a series of basals which are soldered together into a small ring, scarcely to be distinguishd from the upper stem-joint."

No sutures are visible between these basals upon the exterior of the calyx; but sections of a decalcified calyx show them very clearly, though they end just short of the edge, so as not to appear externally. In the same way there is no trace of interbasal sutures in the adult *B. Carpenteri* †, though they are visible in young individuals. In all these three species, however, the interradial sutures are perfectly distinct; while they are always traceable in those specimens of *R. lofotensis* which show no interbasal sutures, even in transverse sections of the decalcified calyx. The same contrast between the persistence of the interradial and interbasal sutures has been noted by Beyrich in the young *Encrinus* ‡, and appears also in the Palæozoic *Allagecrinus* §.

May we not therefore consider the Eugeniacrinidæ as presenting another instance of the total disappearance of the interbasal sutures? Do not the analogies of *Rhizocrinus* and *Bathycrinus*, *Encrinus* and *Allagecrinus*, all point to the conclusion that the so-called uppermost stem-joint of the symmetrical Eugeniacrinidæ really consists of five closely anchylosed basals?

Like the corresponding part of the calyx in *Rhizocrinus* and *Bathycrinus*, it is pierced by five interradial canals, each of which forks just below the synostosis of this piece with the radials above. In *Encrinus*, *Apiocrinus*, *Millericrinus*, *Pentacrinus*, *Metacrinus*, &c., and in the larval *Comatulæ*, each of the basals is perforated by one of these bifurcating interradial canals; and no Crinoid is known with these canals situated anywhere else but in the basals. They lodge the five primary cords which proceed outwards from the chambered organ towards the circular commissure contained within the radial pentagon. The axial cords of the arms originate in this commissure, and are the channels by which motor impulses reach the paired muscular bundles connecting the

* "Notice of new Living Crinoids belonging to the Apiocrinidæ," Journ. Linn. Soc., Zool. vol. xiii. p. 50.

† This is the *Ilycrinus Carpenteri* of Danielssen and Koren. See the 'Nyt Magazin for Naturvidenskaberne,' 23rd Bind, 1877, p. 4 (of separate copy).

‡ Crinoideen des Muschelkalks, pp. 43, 44.

§ Ann. & Mag. Nat. Hist. ser. 5, vol. vii. p. 288.

arm-joints; while the chambered organ in the interior of calyx is the co-ordinating centre in which these impulses originate.

This chambered organ is a constant feature in all Crinoids (perhaps even in all the Pelmatozoa), as shown by the perforation or grooving of the calyx-plates for the reception of these axial cords; and the five primary interradial cords proceeding from it are invariably situated in or upon the basal plates. These plates, therefore, are of fundamental importance in the morphology of a Crinoid; and one would as soon expect to find them absent as that their homologues, the genital plates, should be missing from the calyx of an Urchin. Nevertheless Quenstedt and De Loriol would have us believe that this is really the case in the Eugeniacrinidæ. I feel assured, however, that the basals are really present, though closely united into the so-called "top stem-joint," just as in the Norwegian variety of *Rhizocrinus lofotensis*.

In the recent *Bathycrinus* this basal ring seems to be less closely united to the radials above it than to the stem-joints on which it rests; for a considerable number of stems were obtained by the 'Challenger,' retaining the basal ring at the upper end, which had separated from the rest of the cup at the basiradial suture. I have never heard of a similar case occurring in *Rhizocrinus*; but the Eugeniacrinidæ present abundant instances of it; for by far the larger number of the symmetrical calyces of *Eugeniacrinus* and *Phyllocrinus* which exist in collections consist solely of the five closely united radials. Thus out of twenty-six species of these two genera, which are described by De Loriol, eighteen are known by the radials and arm-joints only. In most cases the sutures separating the radials can be traced over their conjoined under surface as far as the opening of the central funnel. Consequently, according to Quenstedt*, "man kann sich noch auf das Bestimmteste überzeugen dass das interradiale (Becken) fehlt." In some specimens, however, the radials rest on what Quenstedt calls an unusually small stem-joint; and he admits that "man könnte in solchen Fällen leicht versucht werden, darin das eigentliche Basale zu vermuthen, allein es fehlt jede Spur von Zwischennähten." This supposed top stem-joint is sometimes met with still attached to the radials and also in an isolated condition, and Quenstedt admits its resemblance to a ring of anchylosed basals.

Quenstedt's argument that the basals of *Eugeniacrinus* must be absent, because of the directions of the cleavage-

* Petrefactenkunde Deutschlands, IV. Encriniden, pp. 396, 398, 402, &c.

planes in a fractured calyx*, is altogether worthless; for the calyx in question consists of the ring of radials *detached from the top stem-joint* (*anchylosed basals*, mihi). Neither does it follow, as he asserts on p. 407, that if the "top stem-joint" really consists of five anchylosed basals it would show five cleavage-planes, as is the case with the radials, and not three only, as in a specimen figured by Quenstedt; for if the anchylosis had proceeded so far as to obliterate the interbasal sutures, one might surely expect that the independence of their cleavage-planes would be also lost.

In certain species of *Eugeniacrinus*, and notably in *E. nutans*, the whole calyx is considerably inclined to one side, so that its axis makes a more or less open angle with that of the stem. In these individuals the "top stem-joint" is more or less truncated obliquely. Quenstedt calls it the Halsband or Halsstück, and says that it "verengt sich auf einer Seite, kann sogar auf der concaven ganz verschwinden." Among his numerous figures, illustrating the different modifications of form that this piece assumes, there is one which shows nothing externally but a small knob immediately below the interradial suture on the convex side of the calyx. All sorts of gradations, however, can be traced between this condition and that of a large and symmetrical "top stem-joint." Whatever the one is, the other must certainly be of the same nature. But I do not think that the existence of these variations is any very serious objection to the view here advanced, that the "top stem-joint" really consists of a ring of united basals, though I admit that the variations in symmetry are of a somewhat unusual character. Many Neocrinoids (e. g. *Pentacrinus decorus* and *Antedon scrobiculata*) present considerable variations in the actual size of the basal plates; but I cannot call to mind any such variations of symmetry as are presented by the basals of *Eugeniacrinus nutans*, except among certain Palæocrinoids and in the Astrocrinidæ among the Blastoids; and even these do not furnish us with a very exact parallel. Nevertheless I prefer to believe in the presence of these important elements of the calyx of a Crinoid, even though in a modified form, rather than to regard them as absent altogether.

According to Mons. de Loriol†, *Tetracrinus* is distinguished, among other characters, by "l'absence complète de pièces basales, mais la présence, par contre, d'un article basal semblable à celui des *Apiocrinus*, et faisant partie du calice." I cannot help thinking that the name "article basal" is an

* *Op. cit.* p. 398, tab. 105. figs. 57–59.
† Pal. Franç. *l. c.* p. 181.

unfortunate one, as being calculated to mislead. But, apart from this question, there is a great difference between the two pieces to which De Loriol gives this name in *Tetracrinus* and in *Apiocrinus* respectively. Both are marked by ridges and intervening fossæ; and that of *Apiocrinus* has the ridges situated radially, as the fossæ lodge the basals. But in *Tetracrinus* the ridges of the "article basal" (uppermost stem-joint of Quenstedt) are interradial, just as they are in the "top stem-joint" of *Eugeniacrinus*, where, however, they are less distinct. They thus correspond to those on the *basal ring* of *Apiocrinus*, and not to those on the enlarged uppermost stem-joint (article basal), which supports this basal ring. Why, then, should they not be interpreted in the same way as the interradial ridges of *Apiocrinus*, viz. as indicating the median lines of the united basals? May not the interbasal sutures have disappeared in *Tetracrinus* as in the Norwegian variety of *Rhizocrinus*, instead of remaining as in *Apiocrinus*?

Quenstedt* says, however, "Auch diese Stücke (*i. e.* obersten Säulenglieder) haben wie bei den anderen Eugeniacriniten nur drei Blätterbruche, konnen daher ebenfalls nicht als Basalia bedeutet werden." But, as I have pointed out above, we need not necessarily expect to find the same number of cleavage-planes in the closely anchylosed basals as in the united but still individually distinct radials; and I do not think that a mineralogical argument of this kind is of much value in helping us over the morphological difficulties which the supposed absence of basals involves.

Plicatocrinus is another type which is generally said to have no basals; but specimens of it are rarely sufficiently well preserved for a definite opinion to be formed upon this point. According to Zittel† the basals are quite rudimentary and rod-like, and concealed between the radials and the top stem-joint. In this respect, therefore, *Plicatocrinus* would resemble many of the Jurassic *Comatulæ* and certain varietal forms of *Encrinus liliiformis*. The same is probably the case in a few species of the Pentacrinidæ, which are commonly described as being without basals. In one case at least, however, this is due to error. In Baily's original description‡ of *P. Fisheri* the first radials were called the basals; and since the detection of this error it has been generally supposed that no basals appear on the exterior of the calyx, as none are shown in Baily's figure. I have recently, however, had the opportunity of examining for myself the few examples of this rare

* Encriniden, p. 438.
† Palæontologie, p 387.
‡ Ann. & Mag. Nat. Hist. ser 3, vol. vi. pp 25–28, pl 1.

species which are known to science, and was surprised to find that basals are present as usual, having about the same relative size as those of *P. asteria.* I cannot help suspecting, therefore, that some of the other cases of the supposed absence of basals in the Pentacrinidæ may perhaps be due to errors of observation.

This, however, can hardly be the case in the Holopodidæ; but there are other grounds for inferring that even in these aberrant forms the composition of the calyx is perfectly normal. First, as regards *Holopus* itself. Sir Wyville Thomson* believed the cup to be formed by the first, and probably also by the second radials, together with the basals; and the appearances presented by some sections of the lower part of the cup, which had been made by him, certainly seem to indicate the presence of the last-named plates.

Passing to the allied, if not identical, genus *Cyathidium*, it is difficult to determine any thing about the composition of the cup in the Faxoe species; but Schlüter suspects the presence of basals in *C. spileccense*, and thinks he has seen traces of a basiradial suture†. In the genus *Cotylecrinus* the radials rest upon the upper edge of a hollow tube or cup which De Loriol‡ describes as a centrodorsal piece, since he has never detected any trace of sutures in it. Its edge, however, is marked by interradial ridges which separate the depressions lodging the radials; and Zittel§ has consequently suggested that this part of the cup should be regarded as composed of anchylosed basals, a proposition to which I thoroughly assent. I would say the same, and for the same reason, respecting the upper part of the so-called "support" in the recently established genus *Eudesicrinus*, De Loriol‖.

A calyx much resembling that of the Holopodidæ occurs in the Palæozoic *Edriocrinus*, the resemblance of which to *Holopus* has been pointed out by Meek and Worthen. The lower part of the cup is formed in young individuals by five distinct basal plates; but when it approaches maturity and becomes free, "a calcareous deposit is secreted around the base, which covers and obliterates the sutures between the plates"¶. May we not suppose a very similar process to occur in the

* "On the Structure and Relations of the Genus *Holopus*," Proc. Roy. Soc. Edinburgh, 1876–77, vol. ix. p. 407.

† "Ueber einige astylide Crinoiden," Zeitschr. d. deutsch. geol. Gesellsch. Jahrg. 1878, p. 51.

‡ Pal. Franç. *l. c.* pp. 188–192, pls. xix.–xxi.

§ Palæontologie, p. 386.

‖ Pal. Franç. *l. c.* pp. 99, 100, pl. xxix.

¶ Wachsmuth and Springer, "Revision of the Palæocrinoidea," Proc. Philad. Acad. 1879, p. 22.

Holopodidæ, so that the "centrodorsal" of *Cotylecrinus* and the "support" of *Eudesicrinus* should really be considered as composed, in part at least, of anchylosed basals?

Thus, then, I have endeavoured to show that the supposed absence of basals in certain Crinoids mostly rests upon empirical reasoning alone; and that when we come to inquire into the matter rationally, *i. e.* from the point of view of morphology, we not only find good reason to believe in the existence of these plates, but also that their supposed absence involves considerable morphological difficulties.

XLIII.—*Note on* Democrinus Parfaiti. By P. Herbert Carpenter, M.A.

In a recent number of the 'Comptes Rendus'*, Prof. E. Perrier has given a preliminary description of a stalked Crinoid which was dredged by the 'Travailleur' at a depth of 1900 metres off Cape Blanc, on the coast of Morocco. Believing it to be new to science, he has named it *Democrinus Parfaiti*. His description runs as follows:—"Le *Democrinus* se distingue immediatement de tous les autres genres par la composition de son calice formé de cinq longues basales constituant à elles seules un calice en entonnoir; un sillon circulaire sépare ces cinq basales de cinq radiales rudimentaires, en forme de croissant, alternant avec elles et surmontées elles-mêmes de cinq radiales axillaires libres, rectangulaires, mobiles, sur lesquelles se fixent respectivement cinq bras, beaucoup moins larges que les radiales. Ces bras se brisent très facilement au niveau de leur articulation avec les radiales axillaires, qui se rabattent alors sur la voûte du calice." Prof. Perrier adds that in *Rhizocrinus* "les basales sont confondues et le calice formé en partie de radiales."

It would appear therefore that he considers *Democrinus* to differ from *Rhizocrinus* in having basals which are not "confondues," but form the whole of the calyx. He has, however, been misled by the erroneous descriptions of the basals of *Rhizocrinus lofotensis* which were given by Sars and Ludwig; and he seems, like the latter author, to have been unacquainted with the observations of Pourtalès upon the calyces of this species and of *R. Rawsoni*, to which I have referred above †.

* "Sur un nouveau Crinoïde fixé, le *Democrinus Parfaiti*, provenant des dragages du 'Travailleur,'" Comptes Rendus, tome xcvi. no. 7, Feb. 12, 1883, pp. 450, 451. This was translated in the March number of the 'Annals,' ser. 5, vol. ii. pp. 223, 224.

† *Antè*, p 328.

I have the strongest conviction that M. Perrier's Crinoid is not only not a new genus at all, but that it is identical with *Rhizocrinus Rawsoni*, which I have long known to occur on this side of the Atlantic. It was first dredged by Pourtalès off Barbadoes; and he described its cup as "composed of five rather long basals and the rather short first radials." * The "sillon circulaire" described by M. Perrier in *Democrinus* is the constriction of the calyx at the basiradial suture, to which I have referred as one of the characters distinguishing *R. Rawsoni* from *R. lofotensis* †. But I cannot agree with Prof. Perrier in regarding the calyx as formed by the basals only. Although the radials are quite small externally, they have large distal faces for the attachment of muscles and ligaments, the inner surfaces of which form the funnel lodging the lower part of the cœlom. On the same principle one would have to describe the cup of those species of *Antedon* in which the first radials do not appear externally as formed by the centrodorsal only!

The fragmentary condition of the arms in M. Perrier's specimens is nothing unusual. The arms of *Rhizocrinus* very frequently break off at one of the numerous syzygies, so that their more or less complete absence is no proof of their being "extrêmement peu développées" as M. Perrier infers is the case in *Democrinus*. In fact *R. Rawsoni* may have as many as one hundred single joints, or, rather, fifty syzygial pairs, with pinnules on all but the first five. But as the first brachial consists of two parts which are united by a syzygy ‡, it not unfrequently happens that the whole of the arms break away at this syzygy, carrying with them the visceral mass to which the rest of the lower brachials are attached. I strongly suspect that this loss may occur and be made good during life; for I have seen specimens in which the epizygal and the following brachials are much smaller than the hypozygal of the first joint. This is exactly what happens when the arm of a *Comatula* is broken at a syzygy and subsequently repaired. The new epizygal and the following joints are for a while much smaller than the old hypozygal and the brachials below it; and I imagine that Prof. Perrier's specimens with the

* Ill. Cat. Mus. Comp. Zool. viii. p. 28.

† "The Stalked Crinoids of the Caribbean Sea," Bull. Mus. Comp. Zool. vol. x. no. 4, p. 174.

‡ These two parts are described as the second and third radials by Sars and Ludwig, and as the radial axillary and first brachial by M. Perrier. The latter author also speaks of them as united by an "articulation." If this were the case, however, and muscles and ligaments were present, he would most assuredly not have found that the arms break "très facilement" at this point.

"cinq bras beaucoup moins larges que les radiales" are in the same condition.

He notes the absence of pinnules in his examples of *Democrinus*; but unless they have more than six or eight single brachials (= three or four syzygial pairs) this would be nothing remarkable. In *R. lofotensis* the first pinnule-bearing joint is the eighth from the radial, *i. e.* the epizygal of the fourth brachial; while in *R. Rawsoni* it is sometimes this and sometimes the epizygal of the third brachial which bears the first pinnule. Unless therefore the "restes très courts" of the arms of *Democrinus* have more than these three or four syzygial joints, I should not expect them to bear pinnules.

Thus, then, I do not regard *Democrinus Parfaiti* as any thing more than a somewhat elongated variety of *Rhizocrinus Rawsoni*. As pointed out elsewhere *, this species has been dredged among the Azores and in the north-west portion of the Bay of Biscay; so that its discovery off the Morocco coast is a point of some interest.

M. Perrier describes *Democrinus Parfaiti* as the fifteenth known living species of stalked Crinoids. His list comprises the eight species of *Pentacrinus* which are noticed in "The Stalked Crinoids of the Caribbean Sea," together with the two species of *Rhizocrinus*, two of *Bathycrinus* (*B. gracilis* and *B. aldrichianus*), one each of *Hyocrinus* and *Holopus*, and, finally, *Hyponome Sarsii*, Lovén. For this last, however, the name of *Bathycrinus Carpenteri* (*Ilycrinus*, Danielssen and Koren) should be substituted. *Hyponome* has long been disestablished as a genus †; for it is merely the isolated disk of a *Comatula*, and in no way related to the stalked Crinoids. To the above list there will have to be added several species of the new genus *Metacrinus*, Wyville Thomson, MS.

XLIV.—*New Observations on the Dimorphism of the Foraminifera.* By MM. MUNIER-CHALMAS and SCHLUMBERGER ‡.

ONE of us demonstrated in 1880 § that in *Nummulites* and *Assilina* each species was represented by *two forms*, which are still regarded, wrongly, as distinct species. Since that time

* Bull. Mus. Comp. Zool. vol. x. no. 4, p. 174.

† Quart. Journ. Micr. Sci. 1879, vol. xix. new ser. p. 205, and Proc. Roy. Soc. no. 194, 1879, p. 388.

‡ Translated by W. S. Dallas, F.L.S., from the 'Comptes Rendus,' March 26, 1883, p. 862.

§ Bull. Soc. Géol. de France. 3e série. tome viii. p. 300.

we have pursued our researches upon the structure and organization of the principal genera of Miliolidæ:—*Biloculina, Dillina, Fabulina, Lasazina, Triloculina, Trillina, Quinqueloculina, Pentellina,* and *Heterillina.*

It appears from our recent observations that the dimorphism first discovered in the Nummulites occurs also in all the species of Miliolidæ that we have studied; and that it is therefore manifested in both the great divisions of the Foraminifera, Perforata and Imperforata.

The better to display this character it is necessary to notice the general plan of structure of the three principal genera of Miliolidæ.

The *plasmostracum** of the *Biloculinæ, Triloculinæ,* and *Quinqueloculinæ* may be regarded, from a schematic point of view, as formed by a tube coiled round a sphere (central chamber) and presenting, at each half revolution, a constriction which bounds a new chamber larger than the preceding one. The coiling is effected sometimes in a single direction; sometimes, on the contrary, at each half revolution the new chamber departs more or less from the preceding one, and the coiling then follows certain definite directions which pass through the plane of symmetry of the serial chambers.

In the *Biloculinæ* the coiling, taking place in a single direction, remains in the same plane of symmetry, which is consequently common to the two rows of serial and opposite chambers, which surround a central spheroidal initial chamber.

The *Triloculinæ* are coiled in three directions, which give origin to three planes of symmetry making an angle of 120° with each other. From this arrangement it results that the central chamber is surrounded by three rows of serial chambers.

Lastly, in the *Quinqueloculinæ,* which present around the central chamber five rows of the serial chambers, the coiling follows five directions, which define the same number of planes of symmetry, making with each other an angle of 72°.

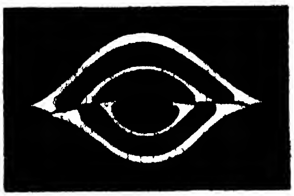
The dimorphism of the Foraminifera is characterized by a difference in the size and arrangement of the first chambers. If we make transverse sections of any of the species that we have investigated, we very soon ascertain that the individuals composing them present two types of organization: the smaller ones and those of medium size have always a relatively very large central chamber (form A), while in the larger specimens this central chamber is only visible with a high magnifying power (form B). In the same species there is no external

* Test of the Foraminifera.

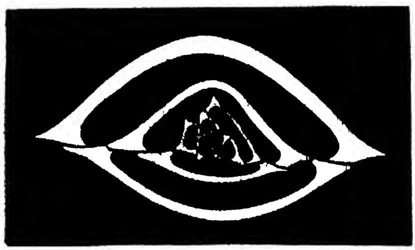
character, except that derived from the size, to lead us to suspect this fact. There exist further, between these two forms, other differences, which we will now indicate.

Form A.—The numerous sections that we have made of individuals belonging to this form have always shown us that they had *a large central chamber*, of a spheroidal form, with thin walls, the diameter of which varies from 200 to 400 μ. The first chambers surrounding it, in the great majority of the species, have a direction and arrangement like those of the last.

A. Fig. 1 (magn. 12).



B. Fig. 2 (magn. 28).



Biloculina depressa.

Biloculina depressa, d'Orb. (fig. 1), which lives in the Atlantic Ocean, may serve as an example. Its central chamber is surrounded by chambers which, from their first appearance, indicate the most simple Biloculinar type, that is to say, coiling in a single direction. The first of the serial chambers, which is often narrower than the following ones, is in communication with the central chamber through a small circular aperture.

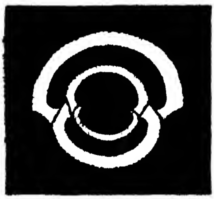
Form B.—Although the individuals belonging to this form are always the largest, transverse sections passing strictly through the centre are very difficult to obtain. The initial chamber, which is likewise spheroidal, is of extreme smallness in comparison with that of the preceding form, its average diameter hardly exceeding 18–25 μ. In all the species that we have studied the first chambers which appear group themselves by five around the central chamber, in accordance with five directions, which recall the mode of development of the *Quinqueloculinæ* and *Pentellinæ*; but soon, either suddenly or by gradual transition, the coiling changes, and the new chambers are arranged, exactly, according to the species, like those of the corresponding form A. The section * of *B. de-*

* The figure represents only the central part of the section; the last two chambers are wanting.

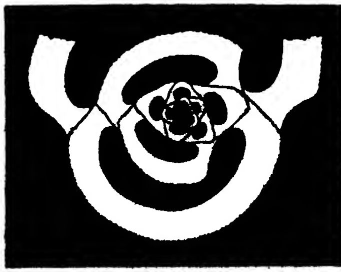
pressa, d'Orb. (fig. 2), shows that the first ten chambers surrounding the central chamber are arranged in five series; but suddenly the succeeding chambers become more embracing and arrange themselves like those of the form A (fig. 1).

Biloculina comata, Brady, form A (fig. 3), which also inhabits the Atlantic Ocean, possesses a central chamber smaller than that of *B. depressa*; its walls are very thin; it

A. Fig. 3 (magn 12).



B. Fig. 4 (magn. 28).



Biloculina comata.

is nearly spheroidal, its greatest diameter being 258 μ, and its smallest 240 μ. Towards its upper part we see the oval section of the first chamber, which resembles a narrow canal and is very different from the following ones. This character, which is common to all the *Biloculinæ*, may be verified in fig. 1.

The following chambers have the normal arrangement of this genus (coiling in a single plane of symmetry); but their walls are very thick and externally present numerous parallel riblets.

Biloculina comata, Brady, form B (fig. 4) *.—The central chamber is spheroidal and very small (21 μ); the first chambers which surround it are grouped at first by five, then by four, three, and two; and it is only from this moment that the chambers are arranged as in the *Biloculinæ*. There is then only a single plane of symmetry common to the last chambers, the coiling taking place in a single direction. These different phases of the coiling therefore remind us, in one and the same species, of the arrangement of the *Quinqueloculinæ*, *Triloculinæ*, and *Biloculinæ*.

In an early communication we shall indicate the modifications that we have ascertained in other genera, and give the

* In our figure the last chamber but one is incomplete, and the last one is entirely wanting.

two principal hypotheses that may be imagined to explain this dimorphism.

The following is a translation of the article referred to as giving the first intimation of the author's observations (Bull. Soc. Géol. France, sér. 3, tome viii. p. 300) :—

"M. Munier-Chalmas announced to the Society that his researches upon *Nummulites lævigata*, *planulata*, *variolaria*, *irregularis*, and upon *Assilina granulata* and *spira*, have led him to conclude that these species are dimorphic. It is probable that this fact will prove to be general.

"When we find in the same deposit Nummulites of very different dimensions which have externally the same specific characters, we very soon remark, on breaking them, that the small individuals have a very large central chamber, while that of the individuals of large size is comparatively very small; and as there are no intermediates between these two forms, they have been made into distinct species. But, on the other hand, as we never find the young of the *small-chambered Nummulites* above mentioned, M. Munier-Chalmas has been led to regard the latter forms as originating from the individuals with large chambers, which are associated with them in most cases. From this he considers it results :—

"1. That the individuals with large chambers continue to increase externally at the same time that they absorb their large central chamber, and that in its place they prolong their spiral inwardly, probably in consequence of a spiral inrolment preexisting in the embryo.

"2. That the individuals which become arrested in their development retain their large chamber without modification: thus, for each of these species, they constitute a peculiar stage corresponding to an arrest of development.

"In the list, in order to avoid confusion between these two stages, one might prefix to the specific name of the individuals with large chambers the designation *præ*, merely indicating a first stage of development. To cite only one example, we should thus have *Nummulites lævigata* for the large individuals with small central chambers, and *N. prælævigata* for the *N. Lamarckii*, or first evolutive phase of *N. lævigata*. If this theory of dimorphism among the Nummulites is verified, it will be necessary to diminish considerably the number of species."

To the above statements M. P. De la Harpe replied at considerable length in a paper read before the Geological

Society of France in January 1881 (Bull. Soc. Géol. France, sér. 3, tome ix. p. 171), in which, after discussing the phenomena observed by him and indicating the pairs of so-called species of Nummulites which he also recognized, he summed up his opinions as follows (*l. c.* p. 175) :—

"If the species of the same couple have some common characters, such as analogous external adornments and septa of the same form and of the same inclination, they have on the other hand plenty of different characters, such as—spirals of which the mode and rate of coiling is different, septa differently spaced and distributed, especially in the vicinity of the centre, and chambers differing in form, size, and number.

"To pass from one form to the other, therefore, we have not merely to prolong the spiral, but to modify it in its essential elements. The internal arrangement of the two forms has been made in accordance with two plans of architecture which are completely different, and of which it is impossible to derive the one from the other.

"Ah! had M. Munier-Chalmas expressed the opinion that these two similar forms are the two sexes of the same species, it would have been more difficult to answer him, so much do the circumstances of their constant association, their relative frequency, and the analogy of their external characters give them the air of a veritable couple. No doubt it will be answered that there is nothing in the organization of the existing Rhizopods to justify one in supposing that there is any separation of sexes in them. But is this answer conclusive? Evidently not.

"Our conclusion therefore is that in each couple of Nummulites there are such anatomical differences between the two forms with and without a central chamber that it is impossible to consider them two ages of the same species. It would be more probable to regard them as the two sexes, if our actual knowledge with regard to the physiology of the Rhizopoda was not opposed to this view."

Remarks upon the subject of the occurrence of pairs of Nummulites as described by M. De la Harpe, and on the presence in them of large and small primordial chambers, will be found in various parts of the 'Catalogue of the Fossil Foraminifera in the Collection of the British Museum,' by Prof. T. Rupert Jones (1882), the supplementary notes to which also contain the translation of a letter from M. De la Harpe to the author relating to the same subject.

XLV.—*Descriptions of new Species of Lizards and Frogs collected by Herr A. Forrer in Mexico.* By G. A. Boulenger.

Eumeces Bocourtii, sp. n.

Head small, its length (from end of snout to posterior border of interparietal) contained nearly six times in the distance from end of snout to vent; snout short, obtuse; cheeks not swollen. Limbs as in *E. Skiltonianus*. Head-shields as in the latter species, but the postnasal smaller, smaller (or at any rate not larger) than the nostril; two pairs of occipitals; postmental not divided. Scales of body equal, in twenty-six longitudinal series; fifty-two or fifty-six transverse series from occipitals to base of tail; no enlarged cervical scales. Two large præanal scales. Tail without enlarged inferior series of scales. Bronze-coloured above, yellowish beneath, the belly washed with greenish; a brown band along each side of head and body, passing through the eye and above the ear; on the head and neck this band is bordered above by a rather indistinct yellowish line; eight longitudinal series of dorsal scales between the two brown bands.

	millim.
Total length	131
From snout to vent	73
From snout to posterior border of interparietal	11
From snout to ear-opening	12
" fore limb	22
Fore limb	17
Hind limb	22
Tail (reproduced)	58

Two specimens from Presidio.

Uta (Phymatolepis) lateralis, sp. n.

Size and proportions of *Phymatolepis bicarinatus*, A. Dum., from which it is distinguished by the following characters:—

The frontal is divided in the middle by a transverse suture, and in contact posteriorly with the large occipital, thus separating the two fronto-parietals.

The two vertebral series of keeled scales formed of much larger, more strongly keeled, and still more regular scales, the length of one of these scales measuring more than half the vertical diameter of the ear-opening; the two series bordered on their inner and outer sides by smaller keeled scales.

No scattered keeled scales among the granules of the back, but a lateral series of irregular keeled scales from the neck to above the hind limb.

The scales of the collar larger, and the denticulation they form less acute.

Abdominal scales a little larger.

The coloration is also different. Upper surfaces grey, tinged with brown; a yellowish-white streak from the tip of the snout, along the upper lip and passing through the tympanum, to the fore limb; a Z-shaped black mark in front of the arm, the posterior branch upon the latter, the anterior branch on the neck, above the white streak; a series of five or six oval or subrhomboidal black spots along each side of the back. Flanks with blackish and whitish spots. Limbs transversely barred with oblique black lines. Lower surfaces whitish, immaculate in the female; in the male, the throat light blue in the middle, and the belly of the same colour, but with the median zone whitish.

Several specimens were collected by Herr Forrer in Western Mexico (Tres Marias Islands and Presidio). *Uta* (*Phymatolepis*) *bicarinata* was also obtained at Presidio by Herr Forrer.

Rana Forreri, sp. n.

Vomerine teeth in two small groups close together, extending beyond the level of the hinder edge of the choanæ. Head moderate; snout broad, rounded, with distinct canthus rostralis; loreal region strongly concave; nostril nearer the eye than the border of the mouth; interorbital space very narrow, not quite half the width of the upper eyelid; tympanum very nearly as large as the eye. Fingers and toes rather pointed, with very small subarticular tubercles; first finger not extending beyond second; toes extensively webbed, though not to the tip; a single small, blunt, metatarsal tubercle. The hind limb being carried forwards along the body, the tibiotarsal articulation reaches the tip of the snout. Back with large, elongate, prominent glandules; a strong, very prominent, glandular lateral fold. Olive above, with suboval, insuliform, light-edged black spots, larger and forming cross bars on the limbs; flanks black-and-white marbled; hinder side of thighs blackish, white-dotted; lower surfaces white, uniform, except greyish variegations on the throat. From snout to vent 72 millim.

The nearest allies of this species are *Rana clamata* and *septentrionalis*.

One female specimen from Presidio.

Rana pustulosa, sp. n.

Vomerine teeth in two short oblique series, extending be-

yond the level of the hinder edge of the choanæ. Head moderate; snout broad, rounded, with distinct canthus rostralis; loreal region deeply concave; nostril equally distant from the eye and the border of the mouth; interorbital space as broad as the upper eyelid; tympanum three fifths the diameter of the eye, separated from the orbit by an interspace equal to its diameter. Fingers and toes with swollen tips and very strong subarticular tubercles; first finger extending beyond second; toes almost entirely webbed, the swollen tips alone being free; a single oval, blunt, metatarsal tubercle. The hind limb being carried forwards along the body, the tibio-tarsal articulation reaches the tip of the mouth. Upper surfaces covered with small pustules; a strong fold from the eye to the shoulder; a glandular lateral fold. Upper surfaces olive, with rather indistinct blackish spots; flanks blackish-and-whitish marbled; hinder side of thighs blackish, marbled with grey; lower surfaces whitish, the throat and breast soiled with grey. From snout to vent 106 millim.

One female specimen from Ventanas.

Hypopachus oxyrrhinus, sp. n.

Snout pointed, very prominent, about once and a half the diameter of the eye. Fore limb much longer than its distance from the tip of the snout; third finger much elongate; toes short, with a rudiment of web; tips of fingers and toes blunt; subarticular tubercles distinct; two very prominent, oval, compressed, shovel-shaped metatarsal tubercles, the inner very large. The hind limb being carried forwards along the body, the tibio-tarsal articulation reaches between the shoulder and the eye. Skin nearly smooth; a fold across the head, behind the eyes. Vinaceous above, blackish on the sides, the limits between the two colours well defined; a black oblique band across the thigh, and another across the leg; hinder side of thighs marbled with blackish; lower surfaces dirty white, more or less marbled with brownish. Male with a subgular vocal sac. From snout to vent 28 millim.

Two male specimens from Presidio.

XLVI.—*Contributions to our Knowledge of the* Spongida.—Pachytragida. By H. J. Carter, F.R.S. &c.

[Plates XIV., XV.]

The Pachytragida or third family of my Holorhaphidota, designated as sponges "more or less corticate, with a can-

cellous, more or less radiated structure internally well differentiated" ('Annals,' 1875, vol. xvi. p. 133), now only consists of three groups, viz. Geodina, Stellettina, and Tethyina; but as it seems to me desirable that a fourth should be inserted between the two latter, this will appear hereafter under the proposed name of "Theneanina," for reasons which will then become evident.

1. Geodina.

The spiculation of this group, whose characters are detailed at length in my Classification (*op. et loc. cit.* p. 183), consists of a "body-" (Pl. XIV. fig. 1, *a*), a "zone-" (fig. 1, *b*), and "anchoring-spicules" (fig. 1, *c*), together with a great number of minute globular siliceous bodies, and still smaller stellates &c. or "flesh-spicules," which are chiefly congregated into a hard crust around the exterior; but as some of these elements may be variously formed, it becomes necessary, for memory's sake, to subdivide the group accordingly; and for this purpose we, of course, select that element which offers the most striking diversity, viz the "zone-spicule." In this we find the following differences:—

Section 1.

Arms simple and straight (or Orthactinida).

a. Radiating more or less forwards. (*Proradiata.*)
b. Radiating horizontally. (*Planiradiata.*)
c. Curved outwards or backwards respectively. (*Recurviradiata.*)

Section 2.

Arms simple, straight, and bifurcated (Dichelactinida).

a. Radiating more or less forwards. (*Proradiata.*)
b. Radiating horizontally. (*Planiradiata.*)
c. Curved outwards or backwards respectively. (*Recurviradiata.*)

Although *Pachymatisma*, Bk. (for illustrations in detail see 'Annals,' 1869, vol. iv. p. 9, pl. ii. figs. 16 *a*, *b*), would thus belong to Section 1, *b*, the body-spicule *here* presents the greatest difference, being more or less cylindrical and obtuse or inflated at both ends (*ib. ib.* fig. 17) instead of fusiform and sharp-pointed, which is the usual form; while the zone-spicule is so abnormally developed in general that it is the exception rather than the rule to find a perfect one. In Schmidt's genus *Caminus* (Spong. Adriat. Meeres, p. 48,

Taf. iii. fig. 27, and Taf. iv. fig. 6) the spiculation appears to be much the same, as evidenced not only by his illustrations, but by the type specimen in the British Museum; hence it appears to be closely allied to *Pachymatisma*.

But *all* the specimens of Geodina which have been described and illustrated will, even after having been placed in the above divisions, be found to be so much alike that the whole group requires to be carefully examined individually as well as collectively, before the little differences which they present specifically can be rightly appreciated for final arrangement. What these "differences" amount to I am unable to suggest, further than that the stellates and other forms of minute flesh-spicules, which often accompany the globular siliceous bodies, may afford some assistance in this way.

There are only two British species enumerated among the sponges in Dr. Bowerbank's Monograph, viz. *Geodia zetlandica* and *Pachymatisma Johnstonia*, of which excellent representations are given in vol. iii. (pls. vii. and viii. figs. 1–9 and 1–7 respectively). But in the *deeper* sea around the British Isles there are many more ("Sponges from the Atlantic Ocean," 'Annals,' 1876, vol. xviii. p. 397 &c. pl. xvi.); and the group is plentifully distributed throughout the warmer regions of the world, from which a great many so-called species have been recorded. But before all have been brought together and properly divided, as just proposed, they must continue as they now are, in hopeless confusion.

Being unable to do more now than propose the divisions of the Geodina above mentioned, I must refer the reader for the little else that I have published on the subject to the "General Observations" in my paper on the West-Indian Sponges ('Annals,' 1882, vol. ix. p. 363).

Geodia canaliculata, Sdt. (Pl. XIV. fig. 1, *a–m*.)

Geodia canaliculata, Spong. Kuste v. Algier, 1868, p. 21, Taf. iv. fig. 7.

It is strange that of this species, which Schmidt calls "new," he should have *only* given the *abnormal* spiculation; so, having found one in Dr. Bowerbank's general collection from Adelaide, on the south coast of Australia, now in the British Museum, I have sought out the *normal* spiculation, which belongs to my Section 2, *b*. Thus the arms of the zone-spicule radiate on the same plane (that is, perpendicular to the shaft), and are each bifurcated (Pl. XIV. fig. 1, *b*), while the normal and fully developed globular or globo-elliptical siliceous body or ball (fig. 1, *d* and *h*) presents that pattern on its surface (fig. 1, *i–k*) which will be more particularly described in the

next group, viz. Stellettina, and is more than twice the size of the abnormal one (fig. 1, *e* and *l*) that accompanies it (see Schmidt's illustration, *l. c.*), which, on the other hand, will be afterwards found to be the *normal* form in the new species that I am about to describe under the name of *Stelletta reticulata*. The entire specimen of *Geodia canaliculata*, according to my "Notes," is subglobular, light fawn-colour throughout, and 3 inches in diameter, with the vents grouped here and there, and a thick cortex, chiefly composed of the normal and abnormal siliceous bodies mentioned.

2. Stellettina.

With reference to the group Stellettina, the name of which is derived from Schmidt's genus "*Stelletta*," established in 1862 (Spong. Adriat. Meeres, p. 46), equivalent to Bowerbank's genus "*Ecionemia*" of 1866 (Mon. Brit. Spong. vol. ii. p. 4, "type *Ecionemia acervus*, Bk., MS."), both of whose diagnoses are *now* remarkably inadequate, the distinction between this and the group Geodina is trenchantly defined if we restrict the siliceous body or ball of the crust to a globular or globo-elliptical form, in which the surface, when fully and normally developed, presents (in all instances that have come under my notice) the tessellated pattern delineated in fig. 1, *i–k* (Pl. XIV.), which is made up of minute, flat, polygonal facets, rendered more or less stelliform by a still smaller spine or ray at each angle, all supported on conical processes, which are the circumferential terminations of the delicate linear crystalline segmental radii of which the whole body is composed, and so closely approximated that, but for a shallow groove or interval not more than one third of the diameter of the facet which separates them (fig. *k*), the whole would be continuous. Thus it becomes very easy, where there is a crust of such globular bodies, to divide *Geodia* from those species of *Stelletta* in which there is none or nothing but a few minute stellates. Hence Schmidt's and Bowerbank's diagnoses of *Stelletta* are so far sufficient. But there are certain other sponges that have been called "*Stelletta*" by Schmidt, as well as some new species which I myself am about to describe, which, although presenting, on the one hand, a thin crust composed of *discoid* bodies otherwise identical in structure with the globular ones of *Geodia* (ex. gr. *Stelletta euastrum*, *S. discophora*, and *S. mamillaris*, Sdt.), and, on the other, bacilliform and globostelliform bodies respectively (ex. gr. *Stelletta bacillifera* and *S. globostellata*, Crtr., n. sp.), cannot be included under the part of Schmidt's diagnosis

which relates to the surface, viz. "*Cortex tenuior, stellas minores 3- ad 7-radiatas continens,*" which is the only characteristic of that form of *Stelletta* to which I have alluded as being thus trenchantly distinguished from the chief cortical element of a genuine *Geodia* in this respect. Hence it becomes desirable either to transfer these to the Geodina, in which case additional sections must be made for them, and the distinguishing character of the Geodina above mentioned is thus rendered useless; or to extend the diagnosis of the Stellettina so as to include them in the latter. Formerly I thought that the discophorous *Stellettæ* should form a part of the Geodina, and so proposed that they should be added to *Pachymatisma* and *Caminus* ('Annals,' 1880, vol. vi. pp. 136, 137), for reasons then mentioned; but now that I have had to consider the relationship of these two groups more closely, it seems to me that they had better remain where Schmidt placed them, viz. under the genus *Stelletta*—that is, with the Stellettina. Thus the diagnosis of the latter would still remain as stated in my classification (*op. et loc. cit.*) unless it should be considered desirable to add to the end of it the following words—"viz. discoid, bacilliform, or globostellate bodies," so as to include the species above mentioned.

The subdivision which I have proposed for the Geodina equally applying to the Stellettina, we have thus to add to it for the latter that which follows, viz.:—

Subsection 1.

Thin-skinned Stellettæ. (Psilodermata.)

a. Cortex thin or next to nothing, charged more or less with minute stellates only. (*Stellifera.*)

b. Cortex the same, but charged with bacilliform bodies chiefly. (*Bacillifera.*)

Subsection 2.

Thick-skinned Stellettæ. (Pycnodermata.)

a. Cortex thick, charged with discoid bodies. (*Discifera.*)

b. Cortex thick, charged with globostellates. (*Globostellata.*)

As regards "Subsection 1, *a*," and generally throughout the Stellettina, the stellates are thin and delicate, so that the fragment under microscopic examination, even in liquor potassæ, requires to be kept there some time before they will make their appearance, and thus are only satisfactorily seen when it is mounted in Canada balsam. This is particularly the case with those of the interior, where the rays are still

more slender and the stellate often without appreciable body or central nucleus (Pl. XIV. fig. 2, *f*, &c.).

In "Subsection 1, *b*," the cortex becomes more defined by the addition of the bacilliform spicule, which then is the dominant element. Its typical form is an obtuse-ended acerate more or less inflated in the centre and microspined throughout (Pl. XIV. fig. 3, *g*), but may vary from elliptical up to that condition in which it is cylindrical or absolutely straight (that is, without curvature or central inflation, and thus essentially a microspined bacillum), while, abnormally, it may pass from a uniaxial into a polyaxial form like that of a stellate, viz. when the primary cell takes to elongating itself in more directions than one (Pl. XIV. fig. 3, *i i i*). In *Ecionemia acervus*, Bk., it is stated to be "fusiform-cylindrical," averaging 1-3000th inch in length by 1-10,000th in its greatest transverse diameter; and in *Ecionemia densa*, Bk., it is represented of an elliptical form, covered with minute tubercles instead of spines (Proc. Zool. Soc. 1873, pl. xxx. figs. 1–6 and 7–14 respectively). Both these species are in the Museum of the Royal College of Surgeons, and are stated to have come from the "Fiji Islands;" while Schmidt, who examined the former in 1866 (Spong. Adriat. Meeres, 2nd Suppl. p. 12), found it to be a species of the genus "*Stelletta*," which he established in 1862 (*ib.* p. 46), and therefore called it "*Stelletta*." Again, the bacilliform spicule is present in *Ecionemia ponderosa*, Bk., from Guernsey, which is identical with the species on the sea-shore rocks here (Burleigh Salterton, S. Devon), that I subsequently described, of course in ignorance of this identity, as *Stelletta aspera* ('Annals,' 1871, vol. vii. p. 8, pl. iv. fig. 12)—but in such a modified form, on account of the length of the spines, that it looks very much like a "spinispirula," and is actually described as "elongo-stellate" by Dr. Bowerbank, who, in his "Terminology" (Mon. B. S. vol. i. fig. 35), uses this name for the spinispirula of *Tethea muricata*. But although the shaft is evidently spiral in the latter, I have never, from its minuteness, been able to satisfy myself that it is so in the former, although I incline to this view. Be it as it may, however, it matters very little; for although this would bring it nearer to *Ecionemia compressa*, as we shall see by-and-by, the conventional line of separation must be drawn somewhere; and the more important part of the spiculation in *Ecionemia ponderosa* allies it most nearly to *Stelletta*, as Schmidt has stated. It is present in *Stelletta Hellerii*, Sdt., from the Adriatic, also in an undescribed species in the general collection of the British Museum (no. 302, registered 40. 1. 1. 1), said to have come from W. Africa; also

among a collection of sponges made by Dr. J. Anderson, F.R.S. &c., around King's Island, on the coast of Burmah; but largest of all in a specimen from the south coast of Australia, in the Bowerbank general collection at the British Museum, in which it is fusiform, straight, microspined, and 11 by 2½-6000ths of an inch in its greatest dimensions (fig. 3, *d* and *f*).

As a typical form of "Subsection 2, *a*," I might instance *Stelletta euastrum*, Sdt., of which the description, illustrated in detail, was published in 1880 ('Annals,' vol. vi. pp. 135–7, pl. vii. fig. 41, *a–l*, and 42, *a*, *c*). *S. discophora*, besides living in the Adriatic, was dredged by Saville Kent on the N.W. coast of Spain and Portugal (no. 21, reg. no. 72. 5. 4, Kent collection, British Museum); and type specimens of this and *S. mamillaris*, Sdt.), also from the Adriatic, may be found among Schmidt's slides of the Adriatic sponges in the British Museum, under nos. 15 and 16 respectively.

Lastly, in the division "*b*" of the same "Subsection" come the two species to be described hereafter under the names of *Stelletta reticulata* and *S. globostellata* respectively, in which the crust from its thickness, resembles that of *Geodia*, and its spicule that of the large globostellate in *Donatia lyncurium*.

The shallow-water British species of *Stelletta* are *Ecionemia ponderosa*, Bk., = *Stelletta aspera*, Crtr., *Stelletta lactea*, Crtr., and *S. Grubii*, Sdt., all of which I have found on the rocks of the seashore about this place (Budleigh-Salterton).

*New Species**.

Stelletta australiensis, Crtr. (Pl. XIV. fig. 2, *a–h*.)

This is a gigantic specimen, stated in my "Notes" to be 12 inches high, 7½ inches broad, and 3 inches thick at the base, from which it diminishes in size upwards so as to become linguiform. The surface is even, but much worn away in

* In the measurements of the spicules the average of the largest is taken; but it should always be remembered that spicules, in this matter like every thing else, grow from small to large, and therefore that, in the sponge, which is a congeries of individuals formed by successive additions of new structure, there may be many small as well as large spicules; also that the length is not always in proportion to the thickness, so that among the average largest spicules some may be longer and thinner while others are shorter and thicker; lastly, not only the size but the form also of the spicules in specimens of the *same* species may slightly differ. Hence a wide margin should be allowed for all this; while our chief object should be to find out and delineate that spiculation which is *normally* representative of the species.

parts, so that the vents were not seen. Skeletal spicules of three forms, viz.:—1, body-spicule, acerate, sharp-pointed, fusiform, smooth, curved, 157 by 4-1800ths inch in its greatest dimensions (fig. 2, *a*); 2, zone-spicule, almost equally long, shaft curved, 160 by 4-1800ths inch, pointed at one end, trifid at the other, arms simple, pointed, carried very much in front and rather curved inwards corolla-like, 14-1800ths inch long (fig. 2, *b*); 3, anchors and forks as usual, with long thin shafts (fig. 2, *c* and *d*). Flesh-spicules of two forms, viz. bacillar and stellate, both very small; the former 2-6000ths inch long (fig. 2, *e*), and the latter the same in diameter (fig. 2, *f*). Incrustation very thin (fig. 2, *g*, *h*).

Hab. Marine.

Loc. Freemantle, west coast of Australia.

Obs. This specimen is in the Bowerbank general collection at the British Museum, and was labelled "Freemantle, W. Australia. Clifton." The smoothness and thinness of the cutis is probably owing to the minuteness of the flesh-spicules with which the dermal sarcode is charged.

Stelletta bacillifera, var. *robusta*, Crtr. (Pl. XIV. fig. 3, *a–f*.)

Conical compressed; head expanded, flat, elliptical, and corrugated from the specimen being dry, sides smooth and furrowed to a point. Vents few and *very* large, each contracted by a wide sarcodic diaphragm, situated in the flat part. Spicules of two kinds, viz. skeletal and flesh-spicules:—1, body-spicule, acerate, sharp-pointed, fusiform, smooth, curved, 93 by 1¾-1800ths inch in greatest dimensions (fig. 3, *a*); 2, zone-spicule, about the same length, shaft straight, about 110 by 2-1800ths inch, pointed at one end, trifid at the other, arms simple, horizontal, recurved, each 3-1800ths long (fig. 3, *b*); 3, anchors alone, no forks seen, anchor-head flattish and expanded, shaft short (fig. 3, *c*). Flesh-spicules of three forms, viz.:—1, bacillar, fusiform, microspined, 11 by 2½-6000ths inch in its greatest dimensions (fig. 3, *d* and *g*); 2, minute, stellate, about 2-6000ths inch in diameter (fig. 3, *e* and *h*); 3, minute, acerate, curved, sometimes undulated, varying in size under 30-6000ths inch (fig. 3, *f*). Incrustation very thin. Size of entire specimen 4 inches high and 6 by 3 inches in diameter across the head or base of the cone-shaped mass.

Hab. Marine.

Loc. Ports Elliot and Adelaide, S. Australia.

Obs. Of this species there are two dozen specimens in the

Bowerbank general collection at the British Museum. The flesh-spicules of the surface in the now dry and corrugated part are mixed with grains of sand, which of course thickens the incrustation, which is very thin in the smooth part or sides, where there is little or no sand. This increased thickness, which in some instances amounts fully to 1-16th inch, must not be set down to an accumulation of the dermal flesh-spicules, but rather to the "habit" of the sponge, which, from its frequent occurrence, appears to be very common with *Stelletta* on the south coast of Australia. In the specimen above described there is a great variety in the form of the bacillar flesh-spicules, which, always very large comparatively, may sometimes be so scantily spined as to be almost smooth; at others the spines themselves may be unusually large, and in some cases the spicule is absolutely cylindrical from end to end, where consequently it is obtuse; while the primary cell, which is normally uniaxial, from its extension in opposite directions, becomes often more or less polyaxial, so as to cause the spicule to present a radiated or stellate form (fig. 3, *i*, *i*, *i*). Small acerates are not uncommonly mixed with the dermal spicules both in *Geodia* and *Stelletta*, where they seem to be connected with the opening and closing of the pore, being situated in an erect circular or flat radiated position around the latter, as the case may be ('Annals,' 1880, vol. vi. pl. vi. fig. 37). I have designated this form as "var. *robusta*," because I have already specifically named one from the coast of Burmah "*bacillifera*," but wherein the bacillar spicule is very small. (MS. Report of a large collection of Sponges from the north-western side of King's Island or Padaw, one of the Mergui archipelago, collected by Dr. J. Anderson, F.R.S., Superintendent, Indian Museum, Calcutta, whence they have been forwarded for my examination.)

Stelletta reticulata, Crtr. (Pl. XIV. fig. 4, *a–f*.)

Irregularly globular, lobate, enclosing two mussel-shells. Surface uniformly reticulated. Vents on the prominent parts of the lobes. Spicules of two kinds, viz. skeleton- and flesh-spicules:—1, body-spicule acerate, sharp-pointed, fusiform, smooth, curved, 65 by 1¾-1800ths inch in its greatest dimensions (fig. 4, *a*); 2, zone-spicule less in length, shaft straight, 40 by 2-1800ths, arms simple, horizontal, 5-1800ths inch long (fig. 4, *b*). Neither anchors nor forks seen. Flesh-spicules of two forms, viz.:—1, globostellate, with the rays, which are thick, conical and prominent, spined over the extremities, which may be truncated or round, 8-6000ths inch in

diameter (fig. 4, *c* and *e*); 2, minute stellate, about 2-6000ths inch in diameter (fig. 4, *d* and *f*). Incrustation, which is strikingly reticulated, comparatively thick, *i. e.* about 1-96th inch in vertical diameter (fig. 4, *g*, *h*). Size of entire specimen 3 inches high and 2 inches in horizontal diameter.

Hab. Marine.

Loc. ——?

Obs. As the large globostellate when fully developed appears to stop at the form and diameter above mentioned, but may be found of all sizes below this, so the former appears to be its *normal* condition, which is almost identical, as before noticed, with the abnormal one of the siliceous body or ball in *Geodia canaliculata*. The characteristic reticulation of the surface from which the designation is taken arises from the dermal sarcode originally presenting this fibro-reticulated structure in a soft state becoming densely charged with the flesh-spicules. Although the specimen bore no label, it was found among Dr. Bowerbank's specimens from the south coast of Australia; and therefore this may have been its "locality"

Stelletta globostellata, Crtr. (Pl. XIV. fig. 5, *a–h*.)

Compressed and corrugated on the surface, probably from desiccation; smooth above, rough below, where it was torn off from the object on which it grew. Surface hard, even, dimpled by a vermiculated reticulation in low relief, the interstice of which presents a pore-opening. Vents congregated in one part of the surface. Spicules of two kinds, viz. skeletal and flesh-spicules:—1, body-spicule, acerate, sharp-pointed, fusiform, smooth, curved, 63 by 1¼-1800ths inch in its greatest dimensions (fig. 5, *a*), 2, zone-spicule not so long, shaft straight, 45 by 1¼-1800ths inch, pointed at one end, trifid at the other, arms thin, long, and horizontal, 13-1800ths in length (fig. 5, *b*). Neither anchors nor forks seen. Flesh-spicules of two forms, viz.:—1, a beautifully clear crystalline globostellate, whose rays are conical, long, smooth, and sharp-pointed, being about one third of the diameter of the whole body, which is 12-6000ths inch (fig. 5, *c* and *e*); 2, small stellate, about 3-6000ths inch in diameter (fig. 5 *d* and *f*). Incrustation white, hard, and comparatively thick, viz. 1-96th inch in vertical diameter (fig. 5, *g*, *h*), contrasting strongly in its white colour with the internal substance, which now, in its dried state, is dirty yellow. Size of entire specimen about 3 inches in horizontal diameter by 1½ thick.

Hab. Marine. On coral-reef.

Loc. Galle, Ceylon.

Obs. This specimen, which is stated to have been taken in the living state from the coral-reef, where it grew, by Dr. Ondaatji, of Ceylon, is now, I understand from Mr. B. W. Priest, who sent it to me, in the British Museum. It is a remarkable species, on account of the form and size of the globostellate of which the crust is chiefly composed, thus presenting at the same time a flesh-spicule like the large globostellate of *Donatia lyncurium* and an incrustation like that of *Geodia*. As in the last species, viz. *S. reticulata*, the fully developed form may be traced up from great minuteness.

3. THENEANINA (new group).

When the late Dr. J. E. Gray was arranging the Spongida for the purpose of classification (Proc. Zool. Soc., May 1867, p. 492), he found it necessary, among other things, to extricate from confusion Dr. Bowerbank's "*Tethea muricata*," and, substituting the term "*Thenea*," while he confined that of "*Tethya*=*Tethea*" to those sponges whose type is *Tethya cranium*, Lam., placed both in his fifth family, viz. the "Tethyadæ." If we do not take this view of the case, the genus is worth nothing; for, misled by Dr. Bowerbank's statement respecting *Tethea muricata* (Mon. B. S. vol. i. p. 25), Dr. Gray gives as the first diagnosis, that the "simple spicules," *i. e.* the body-spicules or acerates, are "not protruded beyond the surface," which is erroneous, inasmuch as their protrusion is common to all the Pachytragida, bearing the same relation as a cat's claw to its sheath, in so far as they can be covered or uncovered as occasion may require. How this should have occurred when Prof. Sollas states that Dr. Gray had a "real knowledge" of this sponge I cannot understand (Sollas, "Report on the Sponge-fauna of Norway," 'Annals,' 1882, vol. ix. p. 429). Subsequently H.M.S. 'Lightning' returned to Oban, on the 21st Sept. 1868, bringing dredgings from the Atlantic Ocean between the north of Scotland and the Faroe Islands, made under the auspices of Dr. Carpenter and Sir (then Dr.) Wyville Thomson; and on the 15th of April of the following year, 1869, Dr. Perceval Wright exhibited at the Dublin Microscopical Society the spiculation of a little sponge which Dr. Wallich had dredged up from the North-Atlantic sea-bed on board H.M.S. 'Bulldog' in 1860, stating that "he (Dr. Wright) would not further for the present allude to it" (Quart. Journ. Microscop. Science, Oct. 1869, p. 422). Sir

Wyville Thomson was also present, and observed "that he had taken this species, or at least one very closely allied to it, on the same ground on which he had taken *Holtenia Carpenteri*" (*ib.* Jan. 1870, p. 81). On the 17th June following, Sir Wyville Thomson communicated his paper on *Holtenia Carpenteri* to the Royal Society, in which, with reference to his proposed classification of the Spongida, he observes:—"The typical vitreous sponges appear to approach the Radiantia through such forms as *Tisiphonia* and *Stelletta*" (Phil. Trans. for 1869, vol. clix. p. 714); therefore at that period he was acquainted with the characters of "*Tisiphonia.*" In January 1870 appeared Dr. Wright's representation and description of the sponge which he had brought before the Dublin Microscopical Society on the 15th April, 1869, now named by him "*Wyvillethomsonia Wallichii*" (Quart. Journ. Microscop. Sci. *l. c.*); and on the 3rd of the same month the late Dr. J. E. Gray wrote to me, enclosing a woodcut of a sponge called "*Tisiphonia agariciformis*" (which Sir Wyville Thomson, then at Dublin, appears to have used at a lecture, whether published or not I know not), adding that "Bowerbank's figures of the spicules in *Tethea muricata* are probably those of *Tisiphonia*, *Wyvillethomsonia*, and *Dorvillia* respectively." This note I still have, although the woodcut was returned after I had made a careful tracing of it in my "Journal," where it now is. Subsequently Saville Kent's representation and description of this sponge under the name of *Dorvillia agariciformis* was published in the number of the 'Monthly Microscopical Journal' for December 1, 1870; and Sir Wyville Thomson's "woodcut," which is the best representation that I have seen of this sponge, was used for illustrating his description of it in 'The Depths of the Sea,' published in 1873.

As Dr. Gray had handed over to me two sets of quarto plates of *Hyalonema lusitanica* and *Tisiphonia agariciformis* respectively, which he had received from Sir Wyville Thomson—evidently drawn for the purpose of accompanying them with letterpress after the manner of his *Holtenia Carpenteri*, had he not been ordered away in H.M.S. 'Challenger'—when he transferred to me all the rest of H.M.S. 'Lightning' and 'Porcupine' sponge-dredgings for my examination and publication, I thought it only right that these two sponges should be left for him to publish himself on some future occasion, as was stated in my account of the 'Porcupine' sponges ('Annals,' 1876, vol. xviii. p. 471, footnote); and this is why I have not until the present time given any attention to *Tisiphonia agariciformis* and its allies beyond their mere mention.

illustrations, but does not appear in Dr. Wright's figure, because this approaches more to the embryonic form, which is spherical, as evidenced by a specimen, not more than the 225th of an inch in diameter, which I accidentally found (and have mounted) on a fragment of a linear sponge-spicule dredged up from the Atlantic Ocean, where this species seems as it were to swarm. Besides this the larger forms of flesh-spicules which Prof. Sollas has termed "quadriradiate stellates" and described in his paper (*l. c.* pp. 433, 434) are incomparably more abundant than in *Tethea muricata*; at the same time, from what he has stated and what I myself have observed, this often appears to be the effect of age; hence Prof. Sollas observes (p. 433) that "it is worth noticing that the quadriradiate stellates are the last spicules to appear in the development of *Thenea Wallichii* [*Wyvillethomsonia Wallichii*]; so that very young examples of this species are not distinguishable from *T. muricata.*"

In the most perfect form of *Wyvillethomsonia Wallichii* that I could find, which, as just stated, is that now before me, the summit is covered with fine anchor-spicules amongst the projecting points of the body-spicules, while the radical cords extended from the other end are of course composed of much stouter ones, so that, as in all the Pachytragida, they may be considered part of the normal spiculation, although, from what has been stated, they may not be always present; that is to say an absence of the *anchor-heads* is of no specific value. As regards the dimensions of this little specimen, it is 1¼ inch long, including the radical cords (four in number), of which the body forms one half. The pileus or hat is 1-12th of an inch in vertical diameter, and the cribriform lace-like dermal structure between it and the rest of the body about the same; while the widest part of the body is the pileus, being now, in the compressed state of the specimen, 5-12ths inch, on either side of which, *i. e.* above and below, it diminishes to the ends respectively, the upper part terminating in the broad osculum at the summit, and the lower part extended somewhat over the radical appendages. Interiorly the upper part of the central line is occupied by a long cup-like cloaca, which opens at the summit through a wide osculum, and the lower part chiefly by the ends of the spicules which go to form the radical cords; while the rest of the body is traversed by a cavernous excretory canal-system like that of *Hyalonema*, which opens into the cloaca. Thus the adult form and the abundance of large flesh-spicules chiefly causes *Wyvillethomsonia Wallichii* to differ from *Tethea muricata*.

Of *Tisiphonia fenestrata*, Sdt., from Bequia, near St. Vincent in the West Indies (Spong. des Meerbusen v. Mexico, 1880, 2. Heft, S. 71, Taf. x. fig. 2), I can state nothing, further than what may be learnt from the description and illustrations, viz. that in form it is nearly allied to *Wyvillethomsonia Wallichii*, and that its spiculation presents no essential difference.

We come now, however, to a very different form in this group, viz. one that is sessile, and not pedunculate like the foregoing; I allude to "*Normania crassa*," of which I now only possess the slides of those dredged on board H.M.S. 'Porcupine,' a specimen of that on *Azorica Pfeifferæ*, and my "Notes" of these and the other two so-called species, viz. *Ecionemia compressa* and *Hymeniacidon placentula*, Bk., to which I have above alluded.

In all these the spiculation is so much alike when the type specimens themselves are examined (but not Dr. Bowerbank's illustrations, Mon. B. S. vol. iii., in two of which, viz. *Normania crassa* and *Hymeniacidon placentula*, the spined and centrally inflated spicules, and in the latter the smaller size of the flesh-spicule also, *are omitted*, although alluded to in the descriptions respectively) that they appear to me to be one and the same species. The body-spicule is, of course, present as a large long acerate; but the zone-spicule is hardly more than rudimentary—that is, reduced to a simple trifid ("attenuato-patento-ternate connecting spiculum," Bk.), in which, as in *Tethya merguiensis* (a new species of Tethyina to be described hereafter), the shaft is hardly to be distinguished in point of form and length from the arms, while the "unusually long bifurcated trifid" is altogether absent. There are of course no anchoring-spicules; but the flesh-spicules, both large and small, are the same; added to which there is a more or less centrally inflated spined acerate, which, in conjunction with the rest of their differences, distinctly distinguishes this species from the type of *Tethea muricata* and from *Wyvillethomsonia Wallichii*. Prof. Sollas therefore is quite right when he states that they are "generically different, although nearly allied" to *Normania crassa* (p. 433, *l. c.*).

I certainly did use the expression "similar variety of *Tethea muricata*," with reference to *Hymeniacidon placentula* and *Normania crassa*, in my attempt to show that Bowerbank's work could claim the earliest mention of these sponges ('Annals,' 1878, vol. ii. p. 176), of which Schmidt says, "Ich schliesse mich dieser Ansicht durchaus an." But it was only done cursorily; for at that time I was engaged in going through the whole of Dr. Bowerbank's type specimens of his British

sponges in the British Museum for the purpose of writing a "Commentary" on them, and had only time to note the relationship; while until now I have not had occasion to return to the subject seriously, and thus now find it necessary to state the result of my investigations more precisely. But when Prof. Sollas observes that I attempted to "impose" the name "*Tisiphonia*" upon *Normania crassa*, because I called the Manaar specimen "*Tisiphonia nana*," it should be remembered that Sir Wyville Thomson, as before stated, had used the term "*Tisiphonia*" six months before "*Wyville-thomsonia Wallichii*" appeared, and that he was then cognizant of the nature of "*Tisiphonia*," or he would not have coupled it with "*Stelletta*;" further, that I was not then prepared to accept Dr. Gray's change of "*Tethea*" to "*Thenea muricata*," and hence had no option but to call the Manaar specimen "*Tisiphonia*."

Lastly, with reference to the Rev. A. M. Norman's statement (Bowerbank's Mon. Brit. Spong. vol. iv. 1882, p. 31, posthumously edited by Mr. Norman), viz. that I speak "very confidently respecting the type specimen of *Normania crassa*, a sponge which is in my cabinet, and which he has never seen," I must reply that I have probably seen more specimens of it than Mr. Norman himself, if, in addition to what I have stated, the specimen in Dr. Bowerbank's collection of British sponges now in the British Museum (that I had long since sketched and examined microscopically with great care), together with the representation and description of Mr. Norman's "cabinet" specimen in Dr. Bowerbank's third volume (plate lxxxi. &c.), be taken into account. Moreover, if the spiculation had been "wholly different" from that of *Tethea muricata*, as Mr. Norman has stated, contrary to the observations of Prof. Sollas and myself, I should in all probability have not "cursorily" stated that *Normania crassa* was only a sessile form of *Tethea muricata*, nor would Schmidt have indorsed my opinion as before stated.

Thus the results of my investigations are as follows, viz. that the term "*Thenea*" for "*Tethea muricata*," as proposed by Dr. Gray, should be accepted and a group headed "Theneanina" formed under the simple diagnosis of "spinispirular flesh-spicules," which should be inserted between Stellettina and Tethyina, in which there should be two genera having the characters of *Tethea muricata* and *Normania crassa* respectively, as above described, but with their names altered also respectively to "*Thenea*," Gray, and "*Ecionemia*," Bk. My reasons for using the term "*Ecionemia*" for the second genus are the following, viz.:—the almost complete identity that exists be-

tween the spiculation of *Ecionemia compressa* and *Normania crassa* (see Dr. Bowerbank's illustrations, vol. iii. pls. ix. and lxxxi. respectively); and the description of the former having been published in 1866 (Mon. B. S. vol. ii. p. 55), while that of *Normania crassa* was not published until 1874 (*ib. ib.* vol. iii. pl. lxxxi. &c.).

It may now be asked, If *Normania crassa*, Bk., and *Hymeniacidon placentula*, Bk., of 1874, are but repetitions of *Ecionemia compressa*, Bk., of 1866, and are to be placed in the group "Theneanina," what is to become of *Ecionemia ponderosa*, Bk., of 1866? The genus, founded by Dr. Bowerbank on a foreign sponge in the museum of the Royal College of Surgeons, had, according to his statement, then *no* "British species" (Mon. B. S. vol. i. p. 174), but Schmidt, who examined it in 1866 (Spong. Adriat. Meeres, 2nd Suppl. S. 12), identified it with his genus "*Stelletta*," whose diagnosis he had published in 1862 (*ib.* p. 46). Bowerbank must have subsequently received the two species which are described in the first vol. of his Monograph (pp. 55 and 56), viz. *Ecionemia compressa* from Shetland and *E. ponderosa* from Guernsey, the former of which I have identified with *Normania crassa*, also from Shetland, and the latter with my *Stelletta aspera* from the shore-rocks of this place, which is on the coast of the English Channel, nearly opposite Guernsey. Hence, then, in matter of priority we must give Schmidt's name to Bowerbank's *Ecionemia ponderosa* and call it "*Stelletta ponderosa.*" Dr. Bowerbank subsequently published an illustrated description of the sponge in the museum of the Royal College of Surgeons under his originally MS. name of *Ecionemia acervus* (Proc. Zool. Soc. 1873, p. 322). So much for dates and nomenclature!

We now come to the *structure* of Bowerbank's *Ecionemia ponderosa*, whereon it may be asked how he came to ally it on the one hand to his *Ecionemia compressa* and on the other to *Ecionemia acervus*.

Probably on account of the flesh-spicule being like the spinispirula of the former, and the rest of the spiculation like that of *S. acervus*; for it is a fact that the *small* flesh-spicule of *Ecionemia ponderosa* is very much like that of *Ecionemia compressa*; wherefore, in my description of *Ecionemia ponderosa* ('Annals,' 1871, vol. viii. p. 8), I have pointed out the difference between it and the spinispirula of *Tethea muricata*; but from its being so small and delicate, having been coarsely represented by myself (*l. c.*), and worse by Dr. Bowerbank (Mon. vol. iii. pl. viii. fig. 14), I cannot satisfy myself *now*, even with a high power, whether the shaft of the flesh-spicule

is straight, like the bacillar flesh-spicule of *Stelletta*, or spiral, like that of *Tethea muricata*, so have placed it in the group Stellettina as the first approach to the bacillar body afterwards so strongly developed in "Subsection 1, *b*," ex. gr. *Stelletta bacillifera*, var. *robusta*. But although it is viewed as a species of *Stelletta*, it cannot be ignored that it is a bordering species which brings the Stellettina close to the Theneanina.

Finally the classification would stand thus:—

THENEANINA, Crtr. (new group).

Char. Microspined spinispirular flesh-spicules *.

Gen. 1. THENEA, Gray.

Char. Pedicellate or rooted. See *anteà*, under *Tethea muricata* and *Wyvillethomsonia Wallichii*, for spiculation.

No. 1. *Thenea muricata*, Bk.

Globoconical in form, with a few large flesh-spicules.

No. 2. *Thenea Wallichii*, Wright.

Agariciform, with a great abundance of large flesh-spicules.

No. 3. *Thenea fenestrata*, Sdt. (*op. et loc. cit.*).

Gen. 2. ECIONEMIA, Bk.

Char. Sessile. See *anteà*, under "*Normania crassa*."

No. 1. *Ecionemia compressa*, Bk.

Without trifurcates or anchoring-spicules, but with the addition of a centrally inflated spiniferous acerate.

No. 2. *Ecionemia nana*, Crtr.

With tricurvates and aborted shaft. For spiculation see 'Annals,' 1880 (vol. vi. p. 138, pl. vii. fig. 43, &c.). The other two species that I have there mentioned are "provisional."

* In *Geodia* the flesh-spicule is essentially the siliceous ball, as above defined, in *Stelletta* a stellate, in Theneanina a spinispirula, and in Tethyina a bihamate.

4. Tethyina.

Lastly, the group Tethyina, whose type is *Tethya cranium*, Lam. (Johnston, Hist. Brit. Spong. 1842, p. 83, pl. i. fig. 1), is closely allied to all the foregoing both in general structure and in spiculation, although generally the species do not present the "zone-spicule," as will appear hereafter, while the flesh-spicule in all instances yet known, with the exception of one in which it has not been seen, is a minute bihamate (*fibula*).

The term "*Tethya*," originally derived from Τηθύς, mythol., hence τῆθος, an oyster, τήθυα, Arist., and *Tethea*, Pliny, was used by Donati, and thus finally became *Tethea* and *Tethya*, Lamarck (Ann. s. Vertebr. 1816, vol. ii. pp. 384, 385), who adopted the generic name of "*Tethya*," originally used in 1750 by Donati for *Tethya sphærica* (= *Tethya lyncurium*, Lam.), for a sponge which O. F. Müller had described under the name of *Alcyonium cranium*, but (*ap.* Johnston) had not figured (Zool. Danicæ Prod. 255, Zool. Dan. tab. lxxv., 1777–1806).

After this Nardo, perhaps seeing that Lamarck had placed two totally different sponges in the same genus, viz. *Tethya* (*op. et loc. cit.*), substituted the generic term "*Donatia*" for Donati's "*Tethya*;" and thus *Tethya cranium*, Lam., remained the same ('Isis,' 1833). Schmidt, however, reversed the thing, and, returning to Donati's original generic name, viz. "*Tethya*," invented that of "*Tetilla*" for Lamarck's "*Tethya*" *cranium* in 1870 (Spongf. Atlant. Geb. p. 66), but very rightly separated the two by placing "*Tethya*" in his Suberitidinæ and "*Tetilla*" in his Anchorinidæ. Still, why Schmidt should have interfered with the distinction which Nardo had made and Dr. Gray in his proposed classification had accepted, that is, by using the name "*Tetilla*" for "*Tethya*" *cranium* as a generic name, which he *first* instituted for a sponge sent to him by Fritz Müller from Desterro, in South America, in 1868 (Spong. Küste v. Algier, p. 40), I am ignorant, seeing that the term "*Tethya*," which Schmidt had reserved for "*Tethya lyncurium*," is here said to be in direct relation with the sponge from Desterro which he called "*Tetilla euplocamus*" ("an eine directe Verwandschaft"). Had he stopped here and only called the sponge from Desterro "*Tetilla*" (although, as will be seen hereafter, it is merely a rooted form of *Tethya cranium* that is widely spread under similar conditions in or probably throughout the tropics), one could have only said that "the distinction generically was not called for;" but when this generic name is carried on in 1870 (*l. c.*) to Lamarck's *Tethya cranium* so typically established in name and illustration by Johnston in 1842 (Hist. Brit. Spong.

p. 83, pl. i. figs. 1–8), and thus so generally accepted, as before stated, one cannot help considering it, to say the least, unnecessary; hence I shall continue to use Lamarck's appellation, viz. *Tethya cranium*, for the typical illustration of my Tethyina.

The skeletal spiculation of this group, the characters of which are detailed at length in my classification (*op. et loc. cit.* p. 184), only differs from that of the foregoing in the absence of the body-spicule, which, however, appears in a rudimentary state in a species that will be described hereafter under the name of *Tethya merguiensis*. I have already, however, alluded to the presence of this spicule in Tethyina (*l. c.*), but have never until now had an opportunity of examining and describing an entire specimen in which it is a general character. My first observation of it was in *Tethya arabica*, where it was partial; and is thus recorded in the description of that sponge:—"In one small portion of the surface which I examined there happened to be several stoutish triradiate spicules with their rays expanded in the circular part, like those of *Geodia*, showing by this occasional occurrence how such characters may be present in species otherwise distinctly different" ('Annals,' 1869, vol. iv. p. 4). I have always regretted that I did not, for preservation and future reference, mount this sponge in Canada balsam; and therefore, on the next occasion that I met with it, which was in a little mutilated specimen about 7-12ths inch in diameter, fixed to a little piece of cardboard in the British Museum (no. 452, reg. no. 40. 10. 23. 8), I did mount a microscopic fragment that is now before me, in which, however, the form of the zone-spicule and the length of its shaft (Pl. XV. fig. 9) shows that it was a different species from *Tethya merguiensis* (fig. 7, *b b*), although the presence of *Carpenteria utricularis* and *Polytrema* with it also pointed to a tropical origin.

With reference to the flesh-spicule, it has been stated above that, in all instances yet known with the exception of one species, viz. *Tethya antarctica*, Crtr. ('Annals,' 1872, vol. ix. p. 414), this is a minute bihamate; yet in some cases the form of this bihamate is so different that the differences alone here are sufficient to constitute a specific distinction, ex. gr. *Tethya atropurpurea*, wherein it is not only unusually large, but furnished scantily with large spines, especially at the ends ('Annals,' 1870, vol. vi. p. 176, pl. xiii. fig. 10). The simple bihamate, too, is very frequently microspined all over, although this is not always so evident as in *Tethya cranium*, var. *abyssorum* ('Annals,' 1876, vol. xviii. p. 405, pl. xvi. fig. 49); while in *Craniella tethyoides*, Sdt. (does not the ana-

grammatized *Tethya cranium* here point to the embarrassment caused by the introduction of "*Tetilla*" for *Tethya* ?), it is represented as wrinkled by transverse elevations, "Querhöckern und Runzeln" (Spong. Atlantisch. Geb. p. 66, Taf. vi. fig. 9). Here I would observe that a sharp turn in the direction of a spicule often presents itself under the illusory form of a globular inflation; hence one termination of the bihamate has been represented in this way in Dr. Bowerbank's illustration of *Tethya cranium* (Mon. B. S. vol. iii. pl. xiv. fig. 5).

Besides the sessile species of Tethyina, *ex. gr.* the type species *Tethya cranium*, there are pedicellate or rooted ones. *Tetilla euplocamus*, Sdt., to which I have already alluded, is one of these, in which the anchoring-spicules are twisted into a cord for about half an inch, like those of *Tethya dactyloidea*, Crtr. ('Annals,' 1869, vol. iii. p. 17, fig. 1, *b*), before they become separated into a lash for fixing-purposes in the sand or mud of a soft sea-bottom, as with the cord of *Hyalonema*. In *Tetilla polyura*, Sdt., which came from Iceland, they are not twisted into a single cord, but proceed at once to their destination in little tufts which issue from papillary eminences, into which the lower part of the body is divided, recalling to mind the radical cords of *Thenea Wallichii* &c. Long before either of these were described I had found *Tethya dactyloidea* on the south-east coast of Arabia (viz. in Dec. 1844), but did not publish my description and illustration of it until 1869; and then I had mislaid part of it, which was not found until 1872; hence the first part appears in the former year ('Annals,' vol. iii. p. 15) and the other in the latter ('Annals,' vol. ix. p. 82). I afterwards found it in the Maham estuary at Bombay, which is also sandy; and just now have received several specimens from the sea about King's Island, off the coast of Burmah, which has a mud-bottom. Thus the radiciferous form of *Tethya* appears to be very general. Besides *Tethya dactyloidea* and *T. merguiensis* there is a robust form of *Tethya cranium*, which grows on the rocks about King's Island, and in my MS. report of the sponges there, to which I have already alluded, has been designated "var. *robusta*," in which the excretory canal-system in its cavernous character resembles that of *Thenea Wallichii* and *Hyalonema Sieboldii*, but, instead of opening into a central cloaca, ends in a series of very large vents situated round the lower third of the sessile globular sponge. However, in the radiciferous form there *is* a short cloaca with single wide osculum at the summit as in *Thenea Wallichii*.

From the above observations, then, it follows that a subdivision of the Tethyina might stand thus:—

Section 1.

Without zone-spicule or ungirled. (Azosta.)

a. Sessile forms. (*Sessilia.*)
b. Rooted forms. (*Radicifera.*)

Section 2.

With zone-spicule. (Zosterophora.)

a. Sessile forms. (*Sessilia.*)
b. Rooted forms. (*Radicifera.*)

The Geodina, Stellettina, and Tethyina are often globular in general form; but this appears to arise from their base of attachment having been destroyed, probably at a very early period of their development, when they adapt themselves to their environment, and thus, having no fixed point, become round.

New Species.

Tethya merguiensis, Crtr.
(Pl. XV. fig. 6, *a–f*, fig. 7, *a–k*, and fig. 8, *a–h*.)

Circular, convex, sessile, depressed, rather constricted at the base (fig. 6, *a–f*). Consistence loose, soft. Colour black-brown. Surface uniformly hispid from the protrusion of spicules, interrupted only by several large vents of different sizes, chiefly situated towards the circumference (fig. 6, *b*). Pores in the interstices of a fibro-dermal reticulation whose sarcode, charged with dark brown pigmental cells and flesh-spicules, is thus rendered strikingly cribriform (fig. 8, *a–h*). Internal structure radiating in large bundles from the centre, which is midway between the base and the summit (fig. 6, *c*, *d*), separating as they advance towards the surface and leaving wide intervals between them, which form a cavernous kind of excretory canal-system that opens at the vents mentioned. Spiculation comprising six forms, viz.:—1, body-spicule (which is by far the largest), acerate, attenuatingly sharp-pointed, fusiform, smooth, nearly straight, about 1-6th by 1-600th inch in its greatest dimensions (fig. 6, *a* and *e*); 2, zone-spicule, smooth, trifid, arms radiating laterally and a little forwards at equal angles from each other and from the shaft, which is so like them in size and shape that, when *in situ*, it is not only almost impossible to say which is which, but whether the spicule is or is not a gigantic 4-rayed stellate of this kind;

arms about 1-56th inch long, occasionally and abnormally bifid at the extremity (fig. 7, *b b*); 3 and 4, anchors and forks setaceous from the great length of their whip-like delicate shafts, heads as usual (fig. 7, *c*, *d*); 5 and 6, flesh-spicules, viz. the usual bihamate, 2½-6000ths inch long (fig. 7, *f* and *h*), and a thin acerate about 1-100th inch long (fig. 7, *g*). Nos. 1, 3, and 4 project in great abundance beyond the surface, where, from their extreme length, they not only give the hispid character, but, from their inclined position, very nearly conceal the vents. No. 2, in its usual position, with the shaft or one ray inwards, is confined to the circumference, where, in plurality, it forms a zonular line. Nos. 5 and 6 are chiefly confined to the dermal sarcode. Pigmental cells, which are abundantly scattered through the sarcode generally, about 1½-6000ths inch in diameter, charged with dark brown spherical granules, which, in combination, give the black-brown colour to the sponge generally (fig. 6, *i* and *k*). Size of specimen about 10-12ths inch in its greatest horizontal diameter, which is between the base and the summit, 6-12ths inch high.

Hab. Marine, growing on hard objects.

Loc. King's Island, Mergui archipelago, coast of Burmah.

Obs. The black colour, together with the presence of a circumferential line of zone-spicules, distinguishes this species from *Tethya cranium*. As far back as 1869 I noticed the presence *partially* of zone-spicules in *Tethea arabica*, and afterwards in an undescribed species generally, as before noticed; but they differed from those above described in the possession of a long shaft and shorter arms, thus more resembling the zone-spicule of *Geodia* &c. (Pl. XV. fig. 9). The reticulated fibro-dermal structure covered by a layer of sarcode, rendered dark and cribriform by the pores, the pigmental cells, and the flesh-spicules, recalls to mind a similar structure in *Thenea Wallichii*, just below the margin of the pileus, being equally striking and beautiful (fig. 8, *c c c*).

I have only met with one specimen of *Tethya merguiensis*; and that is among the collection of sponges made by Dr. Anderson, to which I have alluded. It is accompanied by two sessile specimens, so nearly allied to *Tethya cranium* that I have designated them as "var. *robusta*" in my MS. report, which it is the intention of Dr. Anderson to publish with those of the other Invertebrata collected by him at the same time. Besides these there are the several specimens of *Tethya dactyloidea*, to which I have above alluded; so that the Tethyina are richly represented in this locality.

EXPLANATION OF THE PLATES.

N.B.—All the figures, except the "more magnified" flesh-spicules, are drawn to the scale of 1-24th to 1-1800th inch, in order that their relative sizes may at once be recognized. The "more magnified" views are chiefly on the scale of 1-24th to 1-6000th inch.

In Plate XV. the spiculation of *Tethya merguiensis* is drawn to the scale of 1-48th to 1-1800th inch, as the limits of the Plate would not permit of their being delineated upon that of the preceding Plate, viz. 1-24th to 1-1800th inch.

Plate XIV.

Fig. 1. *Geodia canaliculata*, Sdt., spiculation of. Skeleton-spicules: *a*, body-spicule; *b*, zone-spicule; *c*, anchor, with part of shaft. (Where anchors and forks are not given together, it must not be inferred that the missing one or both were not present, but rather that they were *not seen*.) Flesh-spicules: *d*, siliceous body or ball; *e*, abnormal form of the same; *f*, stellate; *g*, dermal acerate. Scale 1-24th to 1-1800th inch. More magnified views: *h*, siliceous body or ball; *i*, surface-pattern of the same, still more magnified, upper view; *k*, the same, lateral view, *l*, abnormal forms of siliceous ball; *m*, stellate. *h*, *l*, and *m* are to the scale of 1-24th to 1-6000th inch, and *i* and *k* to a still larger scale.

Fig. 2. *Stelletta australiensis*, n. sp., spiculation of. Skeleton-spicules: *a*, body-spicule; *b*, zone-spicule; *c*, anchor; *d*, fork. Flesh-spicules: *e*, bacillar body; *f*, stellate. *g*, fragment magnified 2 diameters, to show thinness of *h*, the crust or cutis.

Fig. 3. *Stelletta bacillifera*, var. *robusta*, n. var., spiculation of. Skeletal spicules: *a*, body-spicule; *b*, zone-spicule; *c*, anchor. Flesh-spicules: *d*, bacilliform body; *e*, stellate; *f*, dermal acerate. More magnified views: *g*, bacilliform body; *h*, stellate; *i i i*, abnormal forms of *g*.

Fig. 4. *Stelletta reticulata*, n. sp., spiculation of. Skeletal spicules: *a*, body-spicule; *b*, zone-spicule (no anchors or forks seen). Flesh-spicules: *c*, globostellate, with rays truncated and spined; *d*, stellate. More magnified views: *e*, globostellate; *f*, stellate.

Fig. 5. *Stelletta globostellata*, n. sp., spiculation of. Skeletal spicules: *a*, body-spicule; *b*, zone-spicule (anchors and forks not seen); *c*, globostellate with rays pointed and smooth; *d*, internal stellate. More magnified views: *e*, globostellate; *f*, internal stellate. *g*, fragment magnified 2 diameters, to show thickness of *h*, the crust or cutis.

Plate XV.

Fig. 6. *Tethya merguiensis*, n. sp., natural size. *a*, upper view; *b*, vents; *c*, lower view; *d*, base of attachment; *e*, lateral view; *f*, base of attachment.

Fig. 7. The same, spiculation of. Skeleton-spicules: *a*, body-spicule; *b b*, zone-spicules; *c*, anchor; *d*, fork. Flesh-spicules: *f*, bihamate; *g*, dermal acerate. *e*, real length of body-spicule. More magnified views: *h*, bihamate or fibula; *i*, pigmental cells; *k*, pigmental cell still more magnified, to show the pigment-granules.

Fig. 8. The same. Interstice of dermal fibro-reticulation, much but *relatively* magnified, to show the elements of the dermis. *a a a a a*,

truncated branches of the dermal fibro-reticulation; *b*, interstice of the same; *c c c*, layer of dermal sarcode, covering the same; *d*, pores in the sarcodal layer; *e*, square portion of the sarcode, filled in with *f*, dermal acerates; *g*, bihamates; and *h*, pigmental cells. Scale 1-48th to 1-6000th inch.

Fig. 9. *Tethya* ——— ? undescribed (no. 452, reg. no. 40. 10. 23. 8 in the British Museum), zone-spicule of. Scale 1-48th to 1-1800th inch. For comparison with fig. 7, *b b*.

XLVII.—*New Genus of Sponges.* By H. J. Carter, F.R.S. &c.

[Plate XV. fig. 10, *a–e*.]

Monanchora clathrata, Crtr., n. sp. et gen.

The specimen of this sponge, which is in the Bowerbank general collection at the British Museum, bears a label on which is written "Freemantle, W. Australia, G. Clifton," but has been rendered so irregular in shape from having been exposed to the action of the waves on the shore, where it was probably picked up for preservation, that it is impossible now to state what this was or to say any more than that its structure is massive and cancellous or clathrous throughout, with a crumb-of-bread texture in appearance and a tawny colour (Pl. XV. fig. 10). The spiculation, however, is *unique*, inasmuch as it presents a sub-pinlike skeletal with a single but remarkable form of flesh-spicule. The former consists of a curved, smooth, pointed shaft, increasing gradually up to the head, which is subterminally inflated, 93 by 2½-6000ths inch in its greatest dimensions (fig. 10, *a*); also another spicule of the same length, but much thinner, with an ovoid terminal inflation resembling that of the skeletal spicule of an *Esperia* (fig. 10, *b*). The latter or flesh-spicule is shaped like the letter C with a straightish back, under a low power like the equianchorate of *Halichondria incrustans* (fig. 10, *c*), but when more magnified is found to have *five* linear arms at each end, that, extending a little inwards towards the centre of the shaft, present a claw-like appearance; these in length are about one fourth of that of the whole spicule, which is 7-6000ths inch, and together form an equianchorate flesh-spicule (fig. 10, *d*, *e*). Size of specimen about 2½ inches in horizontal diameter by 1½ inch high

Hab. Marine.

Loc. Freemantle, W. Australia.

Obs. The form of the flesh-spicule is, so far as is known, unique, although the skeletal spicules and structure of the sponge generally without this combination would be nothing extraordinary. There is, however, a tendency in the latter to a polygonal character (fig. 10); and the surface-interstices were tympanized with sarcode, in which probably the pores were situated.

The nearest approach in form to the flesh-spicule is the *inequi*anchorate represented by Dr. Bowerbank in fig. 135 (Mon. B. S. vol. i. p. 249, pl. vi.), which came from a "parasitical" sponge also found at Freemantle, in Australia, and is likened to an *Esperia* (*Hymeniacidon*, Bk.).

EXPLANATION OF PLATE XV. fig. 10, *a–e*.

Fig. 10. *Monanchora clathrata*, n. gen. et sp., natural size of specimen. *a* and *b*, skeletal spicules; *c*, flesh-spicule. More magnified view of the latter: *d*, front view; *e*, lateral view.

XLVIII.—*On* Mustela albinucha, *Gray*. By Oldfield Thomas, F.Z.S., British Museum.

In the 'Proceedings of the Zoological Society' for 1864 (p. 69), the late Dr. Gray described and figured a brightly coloured weasel from South Africa, under the name of *Zorilla albinucha*; but afterwards, in his 'Catalogue of the Carnivora in the British Museum' (1869, p. 90), he stated that it was a "*Mustela* having the coloration of a *Zorilla*." On an examination of its skull, however, I find that it should be referred to a new genus, on account of the remarkable reduction in the number of its teeth, and of various differences in the general character of its skull. In all I have examined five specimens, of which four are in the British Museum and one is in the Paris Museum. I would propose for the genus the name of *Pœcilogale**. Its dental formula is as follows:—

$$\text{I. } \tfrac{3}{3},\ \text{C. } \tfrac{1}{1},\ \text{P.M. } \tfrac{2}{2},\ \text{M. } \tfrac{1}{1}\ (\text{rarely } \tfrac{1}{2}) \times 2 = 28\ (\text{or } 30).$$

The anterior premolars in both upper and lower jaws are entirely absent; and the minute posterior lower molar present in all other Mustelidæ, with the exception mentioned below, is absent in all the British Museum specimens, but present in

* From ποικίλος, meaning either "particoloured" (which the only species is) or "cunning" (which any weasel may be safely presumed to be).

that belonging to the Paris Museum, the presence or absence of this tooth being therefore a variable character. As to the premolar, there is no diastema where it should stand, and its absence is evidently due to the shortening of the jaws and the consequent strengthening of the biting power of the animal.

One species of Mustelidæ, however, the *Lyncodon patagonicus* of Gervais, is described as having the identical number of teeth ordinarily found in *Pœcilogale*; and I therefore wrote to Prof. W. P. Gervais, of the Paris Museum, asking him if he could allow me to see the original and only known skull of that species, and he has most kindly sent it to me to examine. I find, as might be expected in an animal from Patagonia, that it has no special relationship whatever with the South African *Pœcilogale*, although its dental formula is the same. The whole shape of the skull is different, as may be seen by comparing Prof. Gervais's excellent figures with the woodcuts now given; the auditory bullæ are not so peculiarly flattened as in *Pœcilogale*, being, in fact, unusually inflated; the floor of the meatus is more produced, so that the opening is closer to the glenoid fossa and is not visible on viewing the skull from below. Altogether it is evident that no genus which was supposed to be founded on genetic affinity could contain these two forms, which have independently developed a similar reduction in the number of their teeth.

Finally, not only the colour but the *plan of coloration* (see P. Z. S. 1864, pl. x.) is so absolutely different from that of any other *Mustela*, that that alone would almost furnish a reason for forming a distinct group for the reception of *M. albinucha*.

PROCEEDINGS OF LEARNED SOCIETIES.

GEOLOGICAL SOCIETY.

December 20, 1882.—J. W. Hulke, Esq., F.R.S., President, in the Chair.

The following communication was read:—

"On Generic Characters in the Order Sauropterygia." By Prof. Owen, C.B., F.R.S., F.G.S., &c.

After referring to the subdivision of De la Beche's group of Enaliosauria into the orders Ichthyopterygia and Sauropterygia, the author indicated that the latter showed differences in the proportional length of the neck and the number and form of its vertebræ bearing relation to the size of the head, together with modifications of the teeth, of the sterno-coraco-scapular frame and of the paddle-bones, leading to the formation of two genera, namely *Plesiosaurus* and *Pliosaurus*, the latter so called to indicate the nearer approach made by it to a generalized Saurian type. In Crocodilia the crowns of the teeth show a pair of strong enamel ridges, placed on opposite sides of the teeth; and these occur also in *Pliosaurus*, while in *Plesiosaurus* they are not present. *Pliosaurus* further approaches the fresh-water Saurians by the large size of the head and the shortness of the neck.

The author described the sterno-coraco-scapular frame in the Sauropterygia generally as consisting chiefly of a pair of large coracoid bones meeting in the middle in a straight suture, but separated by a notch anteriorly and posteriorly; in front of these is an episternum, also notched in front; and attached to this on each side is a scapula, directed outward and backward, joined at its distal part by suture to the antero-lateral margin of the coracoid, and forming the outer border of the "coraco-scapular vacuity," a rounded aperture which exists on each side in the fore part of the sterno-coraco-scapular mass. The humeral articulation is formed by the outer margin of the fore part of the coracoid and the extremity of the scapula on each side. The chief distinctive character in *Pliosaurus* consists in the retention of a typical character of the scapula which is lost in the more specialized Plesiosaurian forms, namely the production of part of the blade-bone laterad and dorsad, where it terminates freely, this portion representing the main body of the scapula in the higher vertebrates. In *Pliosaurus* this portion is separated by a large notch from that which in both genera joins the coracoid and assists to form the glenoid cavity. The latter portion also extends further mesiad than in the Plesiosaurs, so that its sutural border unites with the fore end of the coracoid, which is much produced forward. The author finds the true homology of the constituents of this sterno-coraco-scapular mass in the endo-

skeleton of the Chelonia; *Pliosaurus* shows characters resembling those of contemporary Crocodilia. A third modification of the Sauropterygian type is indicated by teeth and a portion of the skull upon which the genus *Polyptychodon* has been founded.

January 24, 1883.—R. Etheridge, Esq., F.R.S., Vice-President, in the Chair.

The following communications were read:—

1. "On *Streptelasma Rœmeri*, sp. nov., from the Wenlock Shale." By Prof. P. Martin Duncan, F.R.S., V.P.G.S.

A great number of simple corals were found amongst the washings of Wenlock Shale prepared by Mr. George Maw, F.G.S.; and most of them belong to a genus new to England, but which has been observed by Messrs. Nicholson and Etheridge at Girvan. The species now described is allied to the Scottish form, but differs in having a fossula in the calice, a smaller septal number, and fewer dissepiments and tabulæ. The author described the new species from sections and perfect corals, showing the great variability of the septal, and the persistence of the calicular arrangement, and explained the remarkable method of growth by increase at certain points of the calice only. He enlarged upon the variability of the same coral during growth, and noticed the bisymmetry of this coral. The relation of the double pinnation of the costæ to the septa was noticed, and also the relation of a constant vertical pair of costæ to the fossula. Agreeing with Messrs. Nicholson and Etheridge upon all material points regarding the diagnosis of *Streptelasma*, the author maintained that there is a true theca with costæ and not a simple epitheca. With those authors he placed the genus in the Zaphrentidæ. The morphological data indicate that transverse sections of Rugose corals are apt to mislead when taken alone as furnishing specific characters.

2. "On *Cyathophyllum Fletcheri*, Edw. & H., sp." By Prof. P. Martin Duncan, F.R.S., V.P.G.S.

This was a short communication explanatory of the finding of this coral in the Wenlock Shale with *Streptelasma Rœmeri*. The author referred to his essay in the 'Philosophical Transactions,' 1867, in which he showed that the group of *Palæocycli*, M.-Edw. & H., belonged to the genus *Cyathophyllum*—to the Rugosa and not to the Fungidæ. Milaschewitsch having associated the name of Kunth with that of the author in proving the non-Fungoid character of the group, it was explained that Kunth wrote in 1869, and that he had nothing whatever to do with the original work. The author alluded to his late researches into the nature of synapticulæ, read before the Linnean Society, and explained the probable cause of the error of the distinguished French zoophytologists in their differentiation of *Palæocyclus porpita*.

3. "On the Fossil Madreporaria of the Great Oolite of the Counties of Gloucester and Oxford." By Robert F. Tomes, Esq., F.G.S.

This paper is in continuation of the papers which the author has already published in the 'Quarterly Journal of the Geological Society.' The author called attention to the fact that there has been sometimes in the study of corals a confusion made between growth by fissiparity and by gemmation. If the former process result from the gradual conjunction of two opposite septa, so as to form a new divisional wall in the calyx, there is no risk of any such confusion; but if the separation has been by the formation of a constriction in the central part of an elongated calyx, this may be, and has been, confused with growth by gemmation.

A large number of the forms here described by the author are in the collection of Mr. T. S. Slatter, F.G.S., and were collected near Fairford, Gloucestershire. They occur in a white marly clay, occurring between the Forest Marble and the Cornbrash. A detailed section was given, and the particulars of some other coralliferous beds. These, the author showed, are not all upon the same horizon, though there is a considerable relation between their coral faunas. The author gave a description of twenty genera and thirty-four species. Of these the following genera are new to the British Oolites:—*Bathycœnia*, a new group of the family Astræidæ (*Eusmilinæ*), containing two species; *Favia*, *Astrocœnia*, *Enallohelia*, and *Trycycloseris* are for the first time recorded as occurring in the British Oolites; and *Confusastræa* and *Oroseris*, recorded by the author from the Inferior Oolite, are now added to the coral-fauna of the Great Oolite. The latter part of the paper consisted of an elaborate description of the genera and species.

February 21, 1883.—J. W. Hulke, Esq., F.R.S.,
President, in the Chair.

The following communication was read:—

"Notes on the Corals and Bryozoans of the Wenlock Shales (Mr. Maw's Washings)." By G. R. Vine, Esq. Communicated by Prof. P. Martin Duncan, M.B., F.R.S., V.P.G.S.

The author briefly discussed the views of different writers upon the systematic position of the genera *Chætetes*, *Monticulipora*, and their allies, and also of the forms referred to the Polyzoa, and gave a list of 39 species and varieties of Corals and Polyzoa obtained by him from Mr. Maw's washings of deposits belonging to the Wenlock series in Shropshire. These forms were referred by him to the genera *Dekayia*, *Monticulipora*, *Callopora*, *Heliolites*, *Thecia*, *Favosites*, *Syringopora*, *Halysites*, *Cœnites*, *Cyathophyllum*, *Lindstræmia*, *Cladopora*, *Leioclema*, *Ceriopora*, and *Ceramopora*. New species are *Leioclema granatum* and *pulchellum*.

March 7, 1883.—J. W. Hulke, Esq., F.R.S., President, in the Chair.

The following communications were read:—

1. "Notes on some Fossils, chiefly Mollusca, from the Inferior Oolite." By the Rev. G. F. Whidborne, M.A., F.G.S.

The fossils described by the author are, with the exception of some in the British Museum and a few of his own collecting, in the collections from the Inferior Oolite which enrich the Bristol Museum. Several of the species are new; of these there are *Ostrea* 2, *Gryphæa* 3, *Exogyra* 1, *Pecten* 4, *Harpax* 1, *Plicatula* 1, *Placuna* 1, *Gervillia* 3, *Pinna* 2, *Lima* 11, *Mytilus* 2, *Arca* 3, *Nucula* 1, *Cardium* 2, *Cypricardia* 1, *Myoconcha* 2, *Astarte* 1, *Opis* 1, *Thracia* 1, *Pholadomya* 3, *Myacites* 1, and *Terebratula* 2, besides one or two more that are doubtful.

2. "On some Fossil Sponges from the Inferior Oolite." By Prof. W. J. Sollas, M.A., F.G.S.

Some fossil Sponges have been described from the Inferior Oolite of the continent; but hitherto none have appeared in the lists of fossils from this formation in British localities. The collection of Sponges described by the author was made by the Rev. G. F. Whidborne. The author described 11 species (6 of which he identified with those already described from continental localities) belonging to 9 genera, and concluded his paper with some general remarks. These Sponges are calcareous, but are considered by the author to have been originally siliceous, replacement of the one mineral by the other having taken place as already noticed by him. The beds in which these Sponges are found bear all the appearance of being comparatively shallow-water deposits.

3. "On the Dinosaurs from the Maastricht Beds." By Prof. H. G. Seeley, F.R.S., F.G.S.

In this paper the author described five fragmentary bones arranged among the remains of *Mosasaurus* in the Van-Breda collection when received by the British Museum. One of these is a femur wanting the distal end, and worn at the proximal extremity, 11½ inches long, with an average thickness of about 1½ inch, and "remarkable for its slender form, its superior bow-shape curvature, the lateral compression of the proximal articulation, and the extent to which it is directed inward, for the trochanter, which is separated from the proximal end of the bone in front, and for the proximal position and small size of the lateral trochanter." For the species indicated by this bone the author proposed the name of *Megalosaurus Bredai*.

Another femur, slightly imperfect at its articular end, 19½ inches long, has a remarkably straight and strong shaft, subtriangular at the proximal end, subquadrate in its lower part, and bearing the lateral trochanter in the middle, and has the proximal and distal

ends modified on the Iguanodont plan. This form was considered by the author nearly allied to *Iguanodon*, and to approach *Hadrosaurus* in most points in which it differs from the former gēnus. He proposed to establish for it a new genus, *Orthomerus*, and to name the species *O. Dolloi*. The collection further included a tibia and metatarsal bone referable to the same form. These Maastricht Dinosaurs furnish the most recent known evidence of the existence of the order.

BIBLIOGRAPHICAL NOTICES.

The Micrographic Dictionary: a Guide to the Examination and Investigation of the Structure and Nature of Microscopic Objects. By J. W. Griffith, M.D., and Arthur Henfrey. Fourth edition, edited by J. W. Griffith, assisted by the Rev. M. J. Berkeley and T. Rupert Jones. 8vo. London: Van Voorst, 1881–3.

It is with no small pleasure that we find ourselves once more called upon to announce the completion of a new edition of this important work. Having assisted, in the French sense of the word at any rate, at the first appearance of the book in 1855, and having welcomed the second edition in 1859, the completion of which was saddened by the recent death of one of the authors, and the third edition in 1874, we not unnaturally feel considerable interest in its success, and a hope that at each successive appearance it may be found to have grown in usefulness as in bulk.

In this respect the purchasers of this fourth edition will have no reason to complain; but, from the very nature of the case, it is impossible for us to say much more on this subject than that a great amount of labour has evidently been bestowed upon the book, and that much new information has been worked into it. The alterations and new articles are necessarily so scattered through the pages of a book the contents of which are alphabetically arranged, that it is for the most part a vain effort to try to seize any thing sufficiently striking to be worthy of special mention. One article, however, we may particularly refer to, namely that on the microscopic structure of rocks, for which the editor acknowledges his indebtedness to Prof. Rutley. This article gives an excellent summary of the principles of petrology, and is illustrated by a very nice plate of coloured figures. The portions of the work dealing with the preparation and preservation of objects have hardly received so much attention as we should have expected; but the article on angular aperture has been remodelled so as to take up the results of recent researches upon this much discussed subject, and a new article on microphotography has been introduced.

Prof. Rupert Jones has again attended to the revision of the parts of the work dealing with the Foraminifera; and the general treatise

on that group, taken in conjunction with the special articles upon the various families and genera scattered through the work, furnishes the best guide at present extant to the classification of those interesting though lowly organisms. Upon Bacterium and the Schizomycetes we find a considerable quantity of new information brought in, as also upon the parasitic insects and Acarina and the Infusoria, derived from the recent publications of Mégnin and Andrew Murray upon the former groups, and from the valuable manual of the Infusoria of Mr. Saville Kent. We are sorry to note, however, that while fully availing himself of the last-mentioned important work, the editor has entirely passed over the most magnificent work that has appeared of recent years upon any group of Protozoa, namely Prof. Leidy's 'Monograph of the Freshwater Rhizopoda of North America.' This is the more to be regretted as, since its publication, a manual founded upon it has been published in America, and there can be no doubt that many of the genera proposed by Prof. Leidy will be frequently referred to in the literature of the microscope.

We had noted several other points in which it seems to us that there is room for improvement; but fault-finding is an unsatisfactory business, and all the deficiencies that we could indicate would but very slightly derogate from the general excellence of the book. Its chief value consists in the immense mass of varied information upon all subjects of interest to microscopists, collected in its pages in a most convenient form for reference; and from the mode of treatment adopted it is, as we have before pointed out, well fitted to serve as a guide in the investigation of many departments of natural history quite outside the domain of microscopic work. On this ground we can recommend it to all students of natural history, and especially to those located in country places at a distance from libraries. To such workers it will prove invaluable as a general book of reference.

The plates with which the volume is illustrated are for the most part the same as in the last edition; but five new ones have been added, bringing the whole number up to fifty-three, a large proportion of them coloured. The immense number of figures contained in these plates, with the numerous woodcuts scattered through the text, render this one of the best-illustrated volumes with which we are acquainted.

A Catalogue of the Collection of Birds formed by the late Hugh Edwin Strickland, M.A., F.R.S., &c. By Osbert Salvin, M.A., F.R.S., Strickland Curator in the University of Cambridge. Cambridge University Press, 1882.

The title of the present volume fully explains its contents, and renders much further explanation unnecessary. It is a descriptive catalogue of the extensive collection of birds formed by the late Mr. Strickland and bequeathed by his widow to the Cambridge

University. Attached to the 'Catalogue' is a supplement or list showing the sources whence the specimens (about 6000 in number) were obtained. Such a work will greatly enhance the value of this collection, to which it forms an almost exhaustive guide; and as such it will doubtless be warmly welcomed by most working ornithologists. Appended to each species is the reference to its original description and to works containing its geographical distribution; but we think that the value and interest of the 'Catalogue' would have been considerably increased if the latter item had been briefly sketched out in a similar manner to that in the British-Museum Catalogues of Birds. The general arrangement adopted, subject to certain necessary modifications and additions, is that elaborated by Messrs. Sclater and Salvin in their 'Nomenclator Avium Neotropicalium,' which has for its basis the system of Huxley.

In the earlier portions of the work (the only ones at present we have had the opportunity of carefully examining) we notice that Mr. Salvin does not admit the distinctness of *Turdus magellanicus* from *Turdus falklandicus*. The latter bird is, we believe, an island form confined to the Falklands, whilst the former is found in various parts of South America. Again, we fail to see why the genus *Merula* should be disregarded when the genera *Oreocincla*, *Geocichla*, *Petrocincla*, and *Zoothera* are recognized. The name *Oreocincla Heinii* of Cabanis surely has the precedence over that of *O. iodura* of Gould, although the former naturalist erroneously gave "Japan" as the locality for his species. We also notice that Mr. Salvin (following Messrs. Blanford and Dresser in their celebrated 'Monograph of the Chats') makes the *Saxicola leucomela* of Pallas synonymous with the *Saxicola lugens* of Lichtenstein, although these two birds are quite distinct. Again, upon what grounds is Cetti's Warbler included in the subfamily Ruticillinæ? Mr. Salvin also makes this bird synonymous with the *Bradypterus platurus* (? *platyurus*) of Swainson. The type of this species (from S. Africa) is in the Cambridge Museum, and was identified as "nothing but Cetti's Warbler" by Mr. Dresser in his 'Birds of Europe,' a conclusion shown to be totally erroneous by Mr. Seebohm in 'The Ibis' for 1878, p. 380. Swainson's generic name will stand for this South-African species; but his specific name must give place (if the law of priority is enforced) to that bestowed by Vieillot; and it will consequently stand as *Bradypterus brachypterus* (Vieill.). Moreover Cetti's Warbler has no claim whatever to be included in the genus *Bradypterus*, nor has it the slightest claim to such a generic title. The type of this genus (*B. brachypterus*) has twelve tail-feathers, whereas the group of Warblers amongst which Cetti's Warbler is included (*Cettia*) is distinguished by having only ten tail-feathers.

We must also strongly protest against the changing of many well-known names—names familiar to us from our childhood—of such birds as the Garden-Warbler, the Whitethroat, the Dartford Warbler, the Reed-Warblers, and the Chiffchaff, and substituting for them unknown synonyms raked up from a just and well-merited

oblivion, or transferring the name of one species to another until it ceases to have any definite meaning.

But apart from these faults and inaccuracies it is impossible to overestimate the value of such a Catalogue, dry enough, it is true, to a non-scientific reader, but to the ornithologist working with the birds in this magnificent collection truly a "friend in need."

Over den bouw der Schelpen van Brachiopoden en Chitonen. (*On the Structure of the Shells of Brachiopods and Chitons.*) *Doctor-Dissertation.* Leiden, 1882. By Dr. J. F. VAN BEMMELIN.

IN this work the author gives a chronological list of the literature relating to the anatomical structure of Brachiopods; a short account of the contents of the most important works, especially with a view to the different opinions entertained with respect to the affinities and homologies of Brachiopods; an historical review of the investigations of others on the structure of their shells; and, finally, some observations of the author's on this subject, illustrated by a few figures, showing the different aspect presented by the under surface of the shell in different parts, and a transverse section through a tubular mantle-papilla.

The chief part of these contents, translated into German, are to be found in "Untersuchungen uber den anatomischen und histologischen Bau der Brachiopoda Testicardinia" in the 'Jenaische Zeitschrift für Naturwissenschaft,' Bd. xvi. neue Folge, Bd. ix. Heft 1 & 2, 1883.

As introduction, a chronological account is given of the views of different authors with respect to the systematic position of Brachiopods; especially the opinions of Steenstrup, Huxley, Hancock, Morse, and the Hertwigs are noticed, and, finally, Butschli's supposition that the Chætognathi are perhaps the nearest allied to Brachiopods, on account of their development, is mentioned.

The structure of the *shell* was investigated by making transverse sections through decalcified fragments. No communication between cæcal cavities in the mantle-tubules and lacunæ or vessels in the mantle itself was found. The corpuscles in these tubules seemed to be for the greater part nuclei belonging to cells that clothe the walls of the shell-perforations. No openings in the periostracum occurred on the tops of the cæca, which tops showed with perfect clearness the radiating ring of fine striations discovered by Carpenter and King.

The number of cæca on the same part of the shell-surface in very old and very young specimens of *Waldheimia cranium* was found to be the same. This fact shows that the distance between two cæca does not change with age, and led the author to the conclusion *that no intussusception occurs during the growth of the shell.*

The bases of the calcareous prisms were found to be very regularly shaped at the margin of the shell, but (especially in *Terebratula* and *Terebratulina septentrionalis*) they became very irregular

towards the older parts. The concentric lines of growth occurring on the outer surface were totally absent on the inner surface, which is explained by supposing the apposition at the margin to stop for some time, the formation of new layers at the whole under surface at the same time continuing.

The chief result of the investigation of the *body-wall* (with its pallial lobes) on surface-views and sections was the demonstration of the *non-existence of the lacunary system described by Hancock.* Under the simple epiblastic epithelial layer was found a homogeneous intercellular substance, containing a reticular network of multipolar cells—a "mesenchymatic" layer. These cells have probably been mistaken by Hancock for a system of lacunary spaces.

At the side of the cœlomic cavity the body-wall shows a layer of flat epithelial cells.

The so-called tendinous portions of the muscles were found to be specially developed portions of the mesenchymatic layer under the real insertions of the muscular fibres. This was most obviously shown in the occlusor muscles of *Waldheimia*, where the tendons are united, to a considerable extent, with the body-wall, and where, in transverse sections, not the slightest difference or limit between them is to be found.

The same origin must be attributed to the peduncle, which, contrary to that of *Lingula*, consists of a solid mass of mesenchymatic tissue containing many fibres. Such fibres are also found in the margin of the mantle and the free or inner walls of its sinuses; they serve for support, and were believed to be muscular by Hancock.

The epiblastic epithelium is everywhere a unicellular layer, except on a small area under the mouth, where the nervous system is in immediate contact with it. No cellular layer was found at the outer surface of the mantle-lobes under the shells; it only showed a reticular design, corresponding to the bases of the shell-prisms, and therefore most regular at the border of the mantle.

The *nervous system* is described by the author as a nervous collar with a large infra- and a small supraœsophageal ganglion. In the description of the first he agrees with Hancock; but in that of the latter he quite differs from him, inasmuch as a median ganglionic mass is described passing on each side, without any sharp demarcation, into a broad nerve, running along the brachial groove and innervating the brachial fold. The commissures uniting this supraœsophageal ganglion with the nervous centrum under the mouth are very thin and supported by two membranous inward prolongations of the body-wall, while the two centra themselves lay in the mesenchymatic substance of the body-wall itself, the supraœsophageal immediately under the ectodermal epithelium, the infraœsophageal separated from it, except along its upper border, by a layer of homogeneous tissue. From the infraœsophageal ganglion also an arm-nerve was found to originate, which, running parallel to the first-mentioned supraœsophageal nerve, innervates the bases of the cirri. Both these arm-nerves were surrounded by a network of many large cells that communicated with them everywhere.

The infraœsophageal arm-nerve resembled even more a concentration of the fibrous prolongations of those multipolar cells than a well-defined nerve; the latter are therefore considered as nervous elements, distributed in the arm-walls and probably connected as follows:—those of the supraœsophageal nerve with the high epithelium of the brachial groove and fold, those of the infraœsophageal with the muscles of the cirri.

On transverse sections, the infraœsophageal centrum was found to consist of two longitudinal masses of small ganglionic cells connected by a broad median commissure of nerve-fibres. This was called by Hancock the median ganglionic mass; and it is, indeed, not quite destitute of nerve-cells.

No ganglionic plexus was to be found in the mantle; nor was the author able to find any trace of the auditory sacs mentioned by Morse as occurring in *Lingula*.

In the investigated species the sexes were found to be separated. The *generative organs* were investigated on transverse sections; and special attention was given to their young tops. The lamella connecting the glands with the body-wall was found to be nothing but an excrescence of the mesenchymatic layer of this wall, on which the cœlomic epithelium continued uninterrupted and unchanged. At the free edge of this supporting lamella an irregular cavity was found, forming a longitudinal canal (Hancock's genital artery). The walls of this canal made many folliculiform evaginations, which at their free surface were covered by the germinal epithelium. In the testes this consists of thick masses of small cells with relatively enormous nuclei. These masses by their bulk and number form a continuous layer around the central cavity. Outside of this another layer was found, consisting of much smaller cells, many of which already show the caudal filaments of spermatozoids, while their nucleus forms the head of them. The masses of germ-cells at the tops of the evaginations gradually pass into the simple epithelial layer of their walls; and this layer is only a continuation of the cœlomic epithelium of the supporting membrane. At the growing tops of the testes nothing but a solid mass of undifferentiated cells was found, showing in its centrum a small lumen, and connected with the body-wall by a small lamella, the epithelium of which passes uninterruptedly into this cell-mass.

No membrane surrounds the germinal layers of the testes; the spermatozoids therefore, when ripe, must fall into the body-cavity.

In the *ovary* the evaginations of the supporting membrane are covered all over with egg-cells in different stages of development. Many were enveloped by a follicle of flattened cells; and these eggs showed a large nucleus and a finely granulated protoplasm: others were destitute of such a follicular membrane; and in this case the nucleus was generally also wanting or very rudimentary, while the plasmatic granules were much coarser. The latter cells, which occurred in all shapes, are considered as on the way of resorption. Between the distinct egg-cells many small germinal cells were found, from which, not only the eggs themselves, but also their fol-

licle-cells are supposed to originate. Towards the side of t[illegible] sup-porting membrane the germinal cells diminish in extent [illegible]s insensibly into the common epithelium of the body-cavity.

At the young top of the ovary no evaginations occur; onl[illegible]ld of the body-wall shows the direction in which the genital g[illegible] is growing. On this fold some of the cœlomic epithelium-cell[illegible]ve increased in size, especially with regard to their nucleus, an[illegible]ow the features of young egg-cells.

By these results the author is led to the conclusion that *t[illegible] ger-minal epithelium is a specially differentiated part of the epithelial layer of the body-cavity.*

In the *nephridial canals* that open with funnel-shaped mouths into the body-cavity egg-cells were often found, this fact proving that, when necessary, the reproductive cells are evacuated in that way, and not, as Gratiolet believed, by pores in the mantle-tissues.

The impregnation is supposed by the author to take place in the sea-water, into which both eggs and spermatozoids are evacuated through the genital funnels; because he cannot believe spermato-zoids to enter the body-cavity of females by the small external openings of these ducts.

The brown spots on the surface of the ovaries, supposed by Han-cock to be the places of origin of the sperma, were found to be accu-mulations of egg-cells undergoing retrogressive metamorphosis. They were also found on the testes, and there consisted of spermatozoid mother cells undergoing the same degeneration.

The microscopical structure of the *muscles* was found to be as Han-cock describes it. They consist of thin longitudinal fibres, perfectly parallel, and probably as long as the whole muscle itself. Apposed externally to these fibres were found nuclei surrounded by a minimal quantity of protoplasm. From this fact, the author believes in the epithelial character of the muscles, which probably have origi-nated from the cœlomic epithelium, and, in becoming independent of it, have retained the nuclei of their formative cells.

All muscular fibres were found to be smooth, with the exception of those of the posterior occlusors, which are distinctly striated. In this fact, already mentioned by Hancock, the author sees a new proof for the assertion of the Hertwigs, that between smooth and striated muscles there need not be any morphological, but only a physiological difference. The occlusores posteriores and anteriores have the same function; they are inserted on the same tendinous mass; but the former are striated, the latter smooth.

The *results* the author believes he has obtained are summed up by him as follows:—

1. The free parts of the body-wall are covered everywhere with a monocellular epiblastic epithelium.

2. Beneath this epithelium is found a mesenchymatic layer of homogeneous substance with interspersed multipolar cellular elements.

3. The tendinous parts of the muscles and the whole peduncle are highly developed parts of this mesenchymatic layer.

4. The nervous system lies imbedded in this mesenchymatic layer; o[illegible] [supraœsophageal ganglion and the] superior margin of the i[illegible]ophageal arc in contact with the ectodermal epithelium.

[illegible]he central nervous system consists of a circumœsophageal ri[illegible]hich not only shows a large infraœsophageal but also a supraœso[illegible]ageal ganglionic centrum of a certain significance. Both these centra give origin to arm-nerves; the nerves of the supraœsophageal are even more important than those of the other ganglion.

6. The nervous centra are formed by thin nervous fibres and very small cells, the peripheral nerves by parallel fibres only, between which nuclei of connective tissue or perhaps of nervous elements are to be found.

7. The arm-nerves are surrounded by and connected with a ganglionic plexus, situated in the supporting tissues of the arm-walls immediately under the ectodermal epithelium, and formed of large multipolar cells and nucleated protoplasmic threads, intercommunicating so as to form a network. No connexion with the neighbouring epithelial cells was discovered; but still this seems very probable.

8. The cœlomic body-cavity is clothed with a flat-celled epithelium.

9. The genital glands are supported by a membranous fold of the mesenchymatic layer containing irregular cavities in its axis.

10. The germinal cells are specially differentiated cells of the cœlomic epithelium.

11. In the investigated species (*Terebratula vitrea*, *Terebratulina septentrionalis*, *Waldheimia cranium*, *Rhynchonella psittacea*) the sexes are separated.

12. The muscles are formed of simple parallel fibres of contractile substance, hardly held together by any connective material, and probably attaining the length of the whole muscle. Adhering to the outer surface of these fibres are nuclei, surrounded by a very small quantity of protoplasm. The striated muscles have in every other respect the same structure as the smooth.

13. The growth of the shells, in thickness as well as in extent, is exclusively the effect of apposition.

14. No lacunary system as described by Hancock is to be found. Probably the reticulum of connective-tissue cells is mistaken by this author for a network of canals.

These results the author believes to confirm to some extent the opinion of the Hertwigs as to the Brachiopods being typical enterocœlic animals. Their muscles are, according to his opinion, "epithelial" organs; their connective tissue, on the contrary, is a mesenchymatic structure playing a very subordinate part; their generative organs are germinal parts of the cœlom-epithelium.

According to the author's opinion, the Brachiopods are closely allied to the Chætognathi. The great external differences between these animals are all attributed by him to the influence of the shells, and so considered secondary changes, while, on the contrary, the

features common to both are called by him chief or primary charac-ters of organization. As such he mentions the similarity in deve-lopment, already pointed out by Butschli and the Hertwigs, the seg-mentation of the larvæ into three segments, the number, position, and origin of the generative organs, and their relations to the nephridial efferent ducts, the perfectly similar structure of the nerve-collar with its two centra, the ventral and dorsal longitudinal and the two pairs of transverse mesenteries. To these facts he adds some remarks on the great similarity in histological structure between Brachiopods and Chætognathes, as the great simplicity of all the epithelial layers, the subordinate significance of the connective tissue, the similar charac-ter of the muscles, the plexiform distribution of peripheral nerves, and the occurrence of horny setæ in ectodermal follicles.

The points of difference between Brachiopods and Chætognathes are explained as consequences of the development of the shell, which in itself cannot be an argument against their affinity. This shell caused the development of the peduncle, the arms, and the muscles, the removal of the anus to the right side or its total disappearance together with eyes, auditory organs (?), and jaws, and perhaps also the unisexuality (to prevent self-fertilization, while cross-fecundation was secured by the animals living in colonies).

As support for this view the author points out the great diffe-rence in plan and structure of peduncle, arms, and muscular system between different kinds of Brachiopods, especially between Testi-cardines and Ecardines.

MISCELLANEOUS.

Echinoderms of the Norwegian North-Atlantic Expedition. By D. C. Danielssen and J. Koren.

The 'Annals' for December last (p. 436) contained a translation of some remarks upon the genus *Solaster*, extracted from a paper by MM. Danielssen and Koren on the Echinoderms collected during the Norwegian North-Atlantic expedition. The article contains a list of the starfishes obtained, numbering forty-one species belonging to twenty genera, four genera and eleven species being indicated as new. The previously known species are *Asterias stellionura*, Perr., *A. panopla*, Stuxb., *A. Mülleri*, M. Sars, *A. grönlandica*, Steenstr., *A. rubens*, Lin., *Stichaster roseus* (O. F. Müll.), *S. albidus* (Stimps.), *Cribrella oculata* (Linck), *Pedicellaster typicus*, M. Sars, *Solaster affinis* (Brandt), *S. furcifer*, Düb. & Kor., *S. papposus* (Linck), *S. endeca* (Gmel.), *Pentagonaster granularis* (O. F. Müll.), *P. hispidus* (M. Sars), *Hippasteria plana* (Linck), *Asterina tumida* (Stuxb.), *Pteraster militaris* (O. F. Müll.), *P. pulvillus*, M. Sars, *P. multipes*, M. Sars, *Hymenaster pellucidus*, W. Thoms., *Astropecten Andromeda*, Müll. & Trosch., *A. arcticas*, M. Sars, *A. irregularis*, Linck, *Cteno-*

discus corniculatus (Linck), *Archaster tenuispinus* (Düb. & Kor.), *A. Parelii* (Düb. & Kor.), *Korethraster hispidus*, W. Thoms., and *Brisinga coronata*, O. Sars.

Of new species the following are indicated, but not described, by the authors, either in the paper cited or in a continuation of it, with an advanced copy of which we have been favoured by them:—*Asterias spitzbergensis, Solaster glacialis* (some particulars of which are, however, indicated in the authors' remarks on that genus), *Tylaster* (g. n.) *Willei*, and *Poraniomorpha* (g. n.) *rosea*.

The species described are:—

1. *Asterias Gunneri.*—Proportion of radii 1 : $5\frac{1}{3}$; disk broad, with a few isolated spines; 5 thick arms, the backs with 5 rows of strong spines, encircled by cruciform pedicellariæ; similar pedicellariæ scattered over the whole back; sides of arms with a row of 26 strong spines surrounded by cruciform pedicellariæ; two rows of ambulacral papillæ, the outer the longest, and outside the ambulacral papillæ a row of 32 long strong spines, half surrounded by cruciform pedicellariæ; dermal skeleton strong. Colour above bright red; the pedicellariæ surrounding the spines form white tufts. Ventral surface yellowish white. From Spitzbergen, in 60 fathoms.

2. *Asterias hyperborea.*—5 rayed; proportion of radii 1 : 6; back with short, thick, close-set spines, surrounded by 2 or 3 cruciform pedicellariæ, placed one above the other; in the middle and at the sides of the arms the spines stand in regular rows; between the spines 1 to 3 tentacle-pores in the naked skin; two rows of ambulacral papillæ. Colour tile-red. From Bear Island, in 35 fathoms.

3. *Stichaster arcticus*—5-rayed, small, convex above, flat beneath. Proportion of the radii 1 : 5. Back covered with groups of clavate spines, forming regular rows on the arms. Ventral marginal spines spatuliform, arranged in pairs. Anal aperture subcentral. Madreporic plate flat, nearly concealed by spines. Colour pale yellowish red; feet dark yellow. From Station 173; N. lat. 69° 17′, E. long. 14° 42′, in 300 fathoms, on mud with stones. Temp. 4°·6 C. (=40°·3 F.).

4. *Asterias Normani.*—5-rayed; diam. 20 millim.; proportion of radii 1 : $3\frac{1}{2}$. Back rather convex, covered with isolated, rather flattened, toothed, oval spines, which are broader at the summit, and usually closely enclosed by a thin transparent membrane, a continuation of the skin, and also by a tubular sheath, wider above, in which the spine is placed, as in a niche, the sheath being able to close up so as to conceal the whole spine except the extreme tip, or to contract so as to form only a narrow ring surrounding its base. The spines are closer and more irregularly placed on the disk than on the arms. The anal aperture is subcentral, and surrounded by small spines of the same kind; and the madreporic plate, which is near an interbrachial angle, is nearly round and has a radiate appearance at the margins. Ventral marginal spines sheathed; sheaths bearing at apex a cruciform pedicellaria. Colour yellowish red on the back; spines and their sheaths white. Ventral surface white. From Station 315; N. lat. 74° 53′, E. long. 15° 15′, at 180 fathoms, firm clay and sand. Temp. 2°·5 C. (=36°·5 F.).

5. *Echinaster scrobiculatus.*—5-rayed; proportion of radii 1 : 3; diameter of disk 4·5 millim.; length of arms 5·5 millim. Back rather flat, strongly reticulate, covered with short isolated spines irregularly arranged. In each mesh a tentacle-pore. Anal aperture subcentral, surrounded by an oblong ring of fine spines; madreporic plate oblong, near the anal aperture. Dorsal marginal spines obtuse and short; ventrals long and more acute. Ambulacral grooves narrow, with three rows of toothed spines, the inner row longest. Colour yellowish red. From Station 195; N. lat. 70° 55′, E. long. 18° 38′, at 107 fathoms, gravel and clay. Temp. 5°·1 C. (= 41°·2 F.).

6. *Bathybiaster* (g. n.) *pallidus.*—For their *Astropecten pallidus* (Nyt Mag. Bd. xxiii. p. 62) the authors establish the new genus *Bathybiaster*, characterized as follows:—"Body depressed, 5-armed, with remarkably broad ambulacral grooves, upon the margins of which there are long pedunculate pedicellariæ. Interbrachial space broad, closely set with sessile pedicellariæ. Dorsal surface clothed with paxillæ; its disk, as well as the middle part of the arms, without tentacle-pores. Dorsal dermal skeleton formed, on the disk and middle part of the arms, by round closely imbricated calcareous plates, in the lateral parts of the arms by stelliform imbricated plates. No anus. Ambulacral pillars."

7. *Ilyaster mirabilis*, g. et sp. n.—The character of the genus is given as follows:—"Body 5-armed. Dorsal surface clothed with paxillæ. From the centre of the back rises a long cylindrical appendage clothed with spines. No anus. Two rows of conically pointed ambulacral feet." The species upon which this new genus is founded is a small starfish measuring 30 millim. across, with a disk 7 millim. in diameter. The proportion of the radii is 1 : 2¼. The paxillæ covering the back are of a round or oblong form, with from 3 to 6 granules and sometimes a central granule. The madreporic plate is oblong, and placed close to the margin of an interbrachial angle. The arms have at their extremities three long conically pointed spines, one attached dorsally and two laterally; they have at the base a small, round, hollow articular surface. The arms have rather broad marginal plates on both surfaces. Colour pale yellowish red with yellowish-white ambulacral feet. A single specimen was obtained from Station 87; N. lat. 64° 2′, E. long. 5° 35′, on a clay bottom, at 498 fathoms. Temp. 1°·1 C. (=30° F.).

From the centre of the dorsal surface of the disk there rises a conical process, 8 millim. long and about 2 millim. in thickness at the base, tapering to a thickness of about 0·5 millim. at the free extremity, which is rounded off This peculiar process feels solid throughout the greater part of its length, and only the wide basal part seems to be hollow. It is entirely clothed with paxillæ, which are distant from each other, and are placed in transverse rows, passing in a sort of spiral from the base to the apex, where there is a very small naked point.

With regard to this remarkable starfish, the authors remark that

there may be some doubt as to whether it is a fully developed animal or only a stage of development. The three spines at the apex of the arms are to be found, although not of the same size, in very young examples of many species of the family Astropectinidæ. In many species of the same family, especially when young, there is also a very small conical protuberance in the centre of the disk; but on comparing such young animals of about the same size as *Ilyaster*, they find that these peculiarities are of such a nature that they can scarcely change in any essential degree with age; and therefore they have felt compelled to form a new genus for the present species.

When alive, *Ilyaster* carries the central dorsal appendage pretty nearly erect; but it moved in small curves, and appeared as if it might have been a ruptured peduncle, by which the animal had been attached. If it be really the remains of such a peduncle, this must have undergone some alteration after the animal became free, as is shown by the form of the free end of the appendage.

At the first glance it seemed that *Ilyaster* might possibly be a young example of *Bathybiaster pallidus*, with which it agrees in many points; but this notion has to be given up on comparing young specimens of *Bathybiaster* with *Ilyaster*. The latter has no pedicellariæ; and where *Bathybiaster* has the large peculiar pedicellariæ, along the ventral grooves, *Ilyaster* has a very large spine. *Ilyaster* has four strong teeth, while young examples of *Bathybiaster* have no teeth, and adult animals only two.

The examination of the small conical prominence of the middle of the disk, which occurs in many species of the Astropectinidæ, shows that it has the same covering of paxillæ as the rest of the back of the disk. It is somewhat otherwise with the appendage in *Ilyaster*. Here the covering is different from that of the disk; so that although we may be inclined to regard the appendix morphologically as a higher development of the above-mentioned small conical knot, it has, at any rate, undergone alterations which cause *Ilyaster* to differ in appearance from all other known starfishes. But the notion that the central conical process of the Astropectinidæ is a residue of a former peduncle by which the animal was attached becomes greatly strengthened by our acquaintance with the dorsal appendage of *Ilyaster*, which undoubtedly points towards the embryonic stage of the Crinoidea. It seems very probable that *Ilyaster* has such a larval stage, and that even when free it will always bear recognizable traces of this earliest period of its existence. If so, we have to do with an extremely interesting phylogenetic phenomenon, namely that the Starfishes have been developed from the Crinoids.

In a supplementary note the authors refer to M. E. Perrier's description of his *Caulaster pedunculatus*, a translation of which appeared in this Journal for February last (p. 151).

They also describe a new species of *Echinus* under the name of *E. Alexandri*, and discuss at some length the characters of the following species—*Pedicellaster typicus*, M. Sars (with which they combine Sladen's *P. palæocrystallus*), and *Korethraster typicus* and

Hymenaster pellucidus of Wyville Thomson, giving revised generic and specific characters for the last two forms.—*Nyt Magazin for Naturvidenskaberne*, Bind xxvii. pp. 267–299, with 4 plates; and Bind xxviii. 10 pp., and 2 plates, 1882–83.

Note on a Peripatus *from the Island of Dominica, West Indies.*

As even isolated facts with regard to this interesting "Arthropod" are of interest, I may state that Mr. G. F. Angas, C.M.Z.S., who has lately returned from an expedition to the island of Dominica, West Indies, has presented to the Trustees of the British Museum the single specimen of *Peripatus* found by him. This example has thirty pairs of feet, not counting the oral papillæ as some confusion has arisen in the mode of counting, I may say that, like Professor Moseley, I find thirty-one pairs of feet in Grube's figure of *P. Edwardsi*. In the present condition of our knowledge it is, as a reference to Mr. Moseley's paper in this journal (ser. 5, iii. pp 263–267) will show, impossible to give definitely a specific name to a single specimen; but I may point out that in the Dominican specimen the form of the "pits on the under surface of the foot-cones" may for some be said to be circular, for others linear, and that there is a similar variation in the extent to which these pores may be said to be distinct; the differences which obtain between examples is due, possibly, to differences in the mode or length of time of preservation. No doubt the monograph commenced by the late Prof. Balfour, and now, as I understand, in course of preparation by Mr. Adam Sedgwick, will set at rest the questions which affect the specific differences of this archaic genus.

F. Jeffrey Bell.

The Breeding of the Sea-Lamprey. By M. L. Ferry.

The author records a circumstance which seems to show that the ova of the sea-lamprey are fecundated while still contained within the body of the female. He says that in the early part of June 1874 a keeper caught in the Allier a female lamprey adhering by its mouth to a boat near Moulins, opened it, and placed the ova in a large pan. As it rained, the pan was soon filled with water; and in about twenty days the ova were all hatched. It has been supposed that the ova of the lamprey were fecundated by the male after expulsion from the body of the female; the author thinks that the relations of the sexes are more intimate, and that the females are fecundated while they and the males are adhering side by side to the same rock or the same tree, a situation in which they are sometimes found in groups, where they remain attached and interlaced in such a manner that it is easy to capture them.—*Comptes Rendus*, March 12, 1883, p. 721.

On Exogone (Exotokas, *Ehlers*) gemmifera, *Pagenst.*
By M. C. Viguier.

In the course of some investigations upon the Annelida of the Bay of Algiers I have met with some interesting types upon which M. Pagenstecher long ago published a curious memoir *. Upon a Syllidian of very small size, to which he gave the name of *Exogone gemmifera*, this naturalist found a series of young animals which he believed to be inserted above each parapodium in the middle region of the worm. The specimen which presented this appearance being destitute of the bundles of long capillary setæ which ordinarily distinguish the sexual generation in the annelids of this group, M. Pagenstecher concluded that it belonged to the agamic generation, and that the larvæ originated from buds developed on the spot. He was confirmed in this idea by the observation of three examples with long setæ, one of which bore ova in the manner already known, and which he thought to represent the sexual generation. To make up for the insufficiency of his own observations, M. Pagenstecher interpreted the previous observations of Œrsted and Krohn in accordance with his theory. The former had taken the animals with long setæ for the males and the others for the females in his *E. naidina*. The second, in his *Syllis pulligera* (*Syllides pulliger*, Clap.), had seen capillary setæ in females still carrying their ova in the cavity of the segments, and thought that in those which carried larvæ the long setæ had disappeared at the time of the hatching of the ova. Both were supposed to have had before them gemmiparous animals without recognizing their true nature. As to the position of the larvæ, it is dorsal according to Krohn and Pagenstecher, ventral according to Œrsted.

At Algiers it is easy to find the type described by M. Pagenstecher; and although the figures that he has published are defective, it is impossible not to recognize that we have to do with the same species. However, we do not find indicated the absence of dorsal cirri upon the second normal segment. Moreover, in the description of the setæ which compose a parapodium, the two different setæ are indicated as *below* the three similar ones. This shows us that the author took the belly for the back, and the ventral cirri, which in fact are not deficient in the second parapodium, for the dorsal cirri. The latter, which are very small, will no doubt have escaped the notice of the author, who does not mention ventral cirri. Further, Ehlers ('Borstenwurmer'), who separates *E. gemmifera* from *Exogone* because of the presence in it of tentacular cirri, and refers it to his genus *Exotokas*, places in the character of the latter genus "*Bauchcirren fehlen.*" It is difficult to distinguish between the dorsal and ventral surfaces if we only examine the animal flattened in a compressorium.

* "Untersuchungen über niedere Seethiere aus Cette: I. *Exogone gemmifera* und einige verwandte Syllidien," Zeitschr. für wiss. Zool. Bd. xii. p. 267.

Krohn no doubt committed the same error. The larvæ are certainly on the ventral side, as Œrsted saw in his *E. naidina*.

I have frequently met with *E. gemmifera*, male and female, in a state of sexual maturity. No error was possible; and in both I have found individuals with long setæ and others which were destitute of them. I know very well that it is said these setæ may become detached in the natatory movements of the animal, and I have seen specimens in which this had probably taken place. But when all the segments are absolutely destitute of setæ doubt is no longer possible, and the more because we observe no trace of the implantation-sacs of the capillary seta. Thus the principal reason which guided M. Pagenstecher disappears. The following is the course of development:—We see an ovum originate at the posterior surface of each dissepiment, starting from the tenth segment (the last three or four segments remaining free), on each side of the median line and below the intestine. The two ova remain always alone in the segment, as indicated by Claparède in his *Pædophylax*, which is perhaps identical; they enlarge until they press the intestine upwards and meet in the median line. Sometimes one of them passes in front of the other, and, their envelopes being very flexible, they mould themselves upon the anfractuosities of the cavity of the segment. After deposition the ovum is attached by a very distinct peduncle to the base of the ventral cirrus. The line of separation is easily seen when the animal is observed from the side and without compression. The ovum is deposited before any segmentation has taken place. The segmentation appears to be very regular; and all the ova pass through the same phase nearly at the same time. As these little annelids die very quickly in captivity, a great number of individuals are necessary in order to observe the successive phases. In the last stage observed in the egg the segmentation was complete, and the ovoid larvæ showed the buccal orifice distinctly. They exactly filled the envelope; and it is no doubt their increase in size that causes its rupture. The larvæ are already naked at the moment when they present the form of an ovoid mass with clear ectodermic cells and strongly coloured endodermic spherules, without the least trace of transverse division. The endodermic mass is cordately emarginate on the side towards the mouth.

These larvæ, which are very convex on the back, show at their free extremity three small scarcely perceptible ectodermic buds, representing the first traces of the tentacles; two other exactly similar buds, situated at the other extremity, will become the anal cirri, which, in the course of their development, pass over on each side of the ventral cirrus of the mother. The point of fixation of the larva is therefore exactly that of the egg. When it becomes detached we do not see the peduncle described by Pagenstecher, but a slight impression at the level of the anus, which perhaps acts as a sucking-disk. The young larvæ enlarge regularly, and do not begin to bear setæ until there are already four or five segments between the head and the anal segment. Thus, just as in the *Autolytus* investigated by A. Agassiz, there is no development of cinctures of

large cilia. And here even the fleece of fine cilia which the last-named author found in the *Autolyti*, and which may be of some use to them as the larvæ are free in the maternal sac, is not developed, the movements of the mother rendering the presence of a locomotive apparatus in the young animal of no use.

I have gone into some details upon this type because it is the one that has served as the foundation of the theory of lateral buds. Such an exception to the general rule, according to which buds are produced in the longitudinal direction in free animals, would have been very difficult to interpret; and it was received with much reserve. M. Mecznikow will not decide upon it; Claparède declared it to be *improbable*; and I only find M. Vaillant who accepts it without hesitation, and cites it in support of another still more singular notion which does not seem to have had a better fate. I do not think, however, that any one has combatted M. Pagenstecher's theory by the actual investigation of his type; but for this I cannot answer in the present state of the University Library of Algiers, and it is a point which I shall look to in the memoir which I propose to devote to this annelid and other allied types. I have not, in fact, confined myself to the investigation of *E. gemmifera*; and I have been able to reexamine all the types spoken of by the German author. In his *E. Martinsi* particularly, which M. Ehlers regards as a true *Syllis*, and which is undoubtedly the *Sphærosyllis pirifera* of Claparède, I have met with males and females of the two forms, with and without long setæ.

This *E. Martinsi* cannot be separated from *E. gemmifera*, and, like it, shows the absence of the dorsal cirrus on the second parapodium. If it is really the *Sphærosyllis* of Claparède, this character escaped the notice of the Genevan naturalist. It would thus be probable that *E. gemmifera* would enter into his genus *Pædophylax*. —*Comptes Rendus*, March 12, 1883, p. 728.

On the Parasites of Anodonta fluviatilis.

Prof. Leidy directed attention to a basketful of living freshwater mussels, *Anodonta fluviatilis*.

The mussels are infested by many water-mites creeping about among the gills. The young of the same, in various stages, were observed imbedded in the mantle. The mite appears to be identical with the species *Atax ypsilophorus*, which is a parasite of the common freshwater mussel (*Anodonta cygnea*) of Europe. It was discovered and described just 100 years ago under the name of *Acarus ypsilophorus* by Dr. Christophori Gottlieb Bonz (Nova Acta Phys. Med. Acad. C. L.C. Nat. Cur., Nuremberg, 1783, p. 52, tab. i. figs. 1–4). It is described and figured by Pfeiffer with the name of *Limnochares anodontæ* (Naturg. deutscher Land und Süsswasser-Mollusken, 1821, Taf. i. fig. 12), by Dr. Karl Ernst v. Baer under the name of *Hydrachne concharum* (Nova Acta, Bonn, 1826, p. 590, Taf. xxix. fig. 19), by P. J. van Beneden (Mém. de l'Acad. R. des Sciences de

Belgique, xxiv. 1850), and by Ed. Claparède (Zeitschr. f. wiss. Zoologie, 1868, p. 445).

Dr. Bonz's description, referring chiefly to the form, colour, and marking of the mite, applies to ours; and, further, Prof. Leidy thought the description of the details of Claparède applies sufficiently well to the same.

The characters of our mite are briefly as follows:—

Body ovoid, black, with a sulphur-yellow median line, often more or less interrupted, forked in front, and ending in an angular spot behind. The yellow marking divides the black into a pair of lateral reniform spots and an interior irregular lozenge spot. Sides brown, from the eggs shining through. Head grey, with dumb-bell eye-spots. Limbs grey, translucent, with the chitinous investment bluish black, hirsute, ending in pairs of double falcate ungues. Terminal joint of the palps ending in three minute uncinate denticles. Anal plates of the females usually with about 18 to 22 acetabula to each. Length of body 1·375 to 1·75 millim., breadth 1·125 to 1·5 millim. Inhabits the branchiæ and mantle of *Anodonta fluviatilis*.

The colours depend mainly on the contents shining through the transparent chitinous investment, which under reflected light exhibits a bluish-black tint. Commonly the black colour is intense; and in alcoholic specimens the whole body is black. In several individuals the black passed into a chocolate hue. Dr. Bonz describes the European mite as black, with the median dorsal mark pale yellow; Pfeiffer as red-brown with a citron-yellow mark; and Van Beneden says it shows a Y in white, from which it was named.

The number of acetabula to the anal plates is variable; in one mite the speaker found 23 to each plate, in a second 22 to each, in a third 22 to one and 17 to the other, and in a fourth 18 to one and 17 to the other. Claparède gives from 15 to 20 as the number to each plate in the European mite.

The variations of our mite from the characters given of the European mite are such as occur among individuals of either; and Prof. Leidy therefore saw nothing distinguishing ours as a different species. Claparede describes another mite which infests the European Unios, which he distinguishes under the name of *Atax Bonzi*. The speaker had also observed a different mite, infesting the common mussel (*Unio complanatus*) of the Delaware river; of this mite he exhibited a drawing made in November 1854. He suspected it to be *Atax Bonzi*; but the question can only be positively answered after the examination of certain details, which he hoped soon to have the opportunity of making.

If our two parasitic mites are identical with those of European mussels, it not only makes it appear probable that they are of common origin, but renders it the more probable that this is likewise the case with their hosts, even if these are not regarded as of the same species.—*Proc. Acad. Nat. Sci. Philad.* Feb. 13, 1883, p. 44.

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XLIX.—*Mediterranean Mollusca* (No. 3) *and other Invertebrata.* By J. Gwyn Jeffreys, LL.D., F.R.S.

[Plate XVI.]

In the 'Annals and Magazine of Natural History' for July 1870, I gave a list of some species dredged by Capt. (now Admiral) Spratt and Capt. (now Sir George) Nares in parts of the Mediterranean, at depths ranging from 20 to 310 fathoms; and in the December number for the same year I added some remarks on the list. Since that time have appeared numerous publications by Professor Aradas, Sr. Benoit, Abbé Brugnone, Prof. Brusina, M. Clément, MM. Dautzenberg and Dollfus, M. Dubreuil, Dr. Fischer, Dr. Foresti, Sr. Granata-Grillo, M. Granger, Dr. Hidalgo, Prof. Issel, Herr Klécak, Dr. Kobelt, Prof. Marion, Prof. v. Martens, the Marchese de Monterosato, M. Morlet, Dr. Schneider, Prof. Seguenza, Prof. Stalio, Sr. M. Stossich, Dr. Tiberi, M. Vayssière, Herr Weinkauff, and myself.

I mention the above list of writers to give some idea of the extent to which this favourite branch of natural history has been carried of late years; but I would especially invite attention to the very useful catalogue of the Marquis de Monterosato, who has done so much to promote our knowledge of

the subject, not only by his own researches, but by his laborious and conscientious study of the synonymy.

Nevertheless the field has not yet been exhausted; nor can it be until the greater depths of the Mediterranean have been sufficiently explored. The Italians and French have, within the last few years, done something to supplement the short and tentative expedition of the 'Porcupine' in 1870; and the former intend this year to continue their exploration on a larger scale, under the direction of their eminent zoologist Prof. Giglioli.

I now propose to add another contribution, in consequence of my friend Admiral Spratt having kindly placed at my disposal a small quantity of material which he dredged, about thirty years ago, off Crete, in from 70 to 120 fathoms. Most of the species are small, and many of them minute. For the "triage" of this dredged material I am indebted to the careful and scientific industry of Mr. and Mrs. David Robertson of Glendale, near Glasgow. Mr. Robertson has also obligingly supplied me with lists of the Ostracoda and Foraminifera which he found with the Mollusca, and which I will subjoin to the present list of Mollusca.

I would refer to my papers on the Mollusca of the 'Lightning' and 'Porcupine' expeditions in the 'Proceedings of the Zoological Society of London' for 1878, 1879, 1881, 1882, and 1883, for the geographical and geological distribution of the following species, as well as for their synonyms.

BRACHIOPODA.

Argiope decollata, Chemnitz.

CONCHIFERA.

Anomia ephippium, Linné, and var. *aculeata*.
Pecten pes-lutræ, L. *P. similis*, Laskey.
Lima elliptica, Jeffreys.
Mytilus phaseolinus, Philippi.
Dacrydium vitreum (Holböll), Möller.
Arca lactea, L. *A. pectunculoïdes*, Scacchi.
Leda fragilis, Chemn. *L. pella*, L.
Nucula ægeensis, Forbes. *N. sulcata*, Bronn. *N. nitida*, G. B. Sowerby.
Montacuta bidentata, Montagu.
Loripes fragilis, Ph. *L. divaricatus*, L.
Axinus croulinensis, Jeffreys.
Cardita aculeata, Poli.

Cardium ciliare, L. *C. echinatum*, L. *C. minimum*, Ph.
Isocardia cor, L.; fry. Hundreds of specimens.
Circe minima, Mont.
Venus rudis, Poli. *V. fasciata*, Da Costa. *V. ovata*, Pennant.
Tapes aureus, Gmelin.
Mactra subtruncata, Da Costa.
Scrobicularia longicallus, Sc. *S. alba*, W. Wood. *S. prismatica*, Mont.
Pandora inæquivalvis, L.
Poromya granulata, Nyst and Westendorff.
Neæra cuspidata, Olivi. *N. costellata*, Deshayes.
Corbula gibba, Ol.
Saxicava rugosa, L.
Xylophaga dorsalis, Turton.

Solenoconchia.

Dentalium dentalis, L. *D. filum*, G. B. Sowerby, Jun.
Siphodentalium lofotense, M. Sars. *S. quinquangulare*, Forb.

Gastropoda.

Tectura virginea, Müller.
Emarginula rosea, Bell. *E. cancellata*, Ph. *E. papillosa*, Risso.
Calyptræa chinensis, L.
Scissurella crispata, Fleming.

Cyclostrema minutum *, Jeffreys. (Pl. XVI. fig. 1.)

Shell globular, with a somewhat oblique outline, rather thin, transparent, and glossy: *sculpture*, none: *colour* clear white: *spire* raised, but short: *whorls* 3, convex; the last equals three fourths of the shell; top whorl prominent and twisted: *suture* rather deep: *mouth* circular, with a tendency to angularity at the upper corner; peristome continuous, but not so completely disunited from the periphery as in other species of this genus: *umbilicus* contracted, with a small perforation: *operculum* chitinous, multispiral. L. 0·025, B. 0·025.

Of this microscopic but peculiar species I found about two hundred specimens. *Rissoa fulgida* might have been supposed to be one of the most minute of European marine shells; but the present species is not one third of its size.

Trochus magus, L. *T. fanulum*, Gm. *T. Guttadauri*, Ph.

* Minute.

T. Adansoni, Payraudeau. *T. Montacuti*, W. Wood. *T. striatus*, L. *T. exasperatus*, Penn.
Clanculus cruciatus, L.
Turbo rugosus, L. *T. sanguineus*, L.
Rissoa cimex, L. *R. calathus*, Forb. & Hanl. *R. reticulata*, Mont. *R. cimicoïdes*, Forb. *R. zetlandica*, Mont. *R. Testæ*, Aradas. *R. punctura*, Mont. *R. variabilis*, v. Mühlfeldt. *R. costulata*, Alder. *R. pulchella*, Ph. *R. inconspicua*, Ald. *R. obtusa*, Cantraine.

Rissoa concinnata *, Jeffreys. (Pl. XVI. fig. 2.)

Shell forming a short cylinder, moderately solid, semitransparent, and glossy: *sculpture*, none except some slight and remote lines of growth on the last whorl: *colour* whitish: *spire* extended; apex blunt: *whorls* 4, convex, gradually enlarging; top whorl regular: *suture* deep: *mouth* nearly round: *outer lip* sharp: *inner lip* adhering to the lower part of the periphery: *umbilicus* shallow, but imperforate. L. 0·03, B. 0·02.

About sixty specimens. This differs from *R. obtusa* of Cantraine not only in its much smaller size, but in its cylindrical shape, the absence of spiral striæ, and the deeper suture.

Rissoina decussata, Mont.
Jeffreysia cylindrica, Jeffr.
Vermetus semisurrectus, Bivona.
Turritella terebra, L., var. *gracilis*. *T. pusilla*, Jeffr.
Scalaria Cantrainei, Weinkauff. *S. pulchella*, Biv.
Aclis ascaris, Turt.

Aclis attenuans †, Jeffreys. (Pl. XVI. fig. 3.)

Shell forming an elongated cone, thin, semitransparent, and glossy: *sculpture*, none: *colour* clear white: *spire* gradually tapering to a rather fine point: *whorls* 6–7, convex; the last, with the mouth upwards, equals the rest of the shell; first whorl globular: *suture* well defined but not deep, nearly straight: *mouth* projecting, more round than oval and inclined to squarish, contracted above and effuse or spread out below; the base is entire and not sinuous or notched: *outer lip* sharp-edged, expanding: *inner lip* or pillar curved, somewhat reflected and thickened behind, where there is a slight chink but no perforation. L. 0·05, B. 0·03.

Ten specimens. *A. Gulsonæ* is its nearest ally; but that

* Fitly joined together. † Lessening.

shell is four times as large and cylindrical, and it has the mouth sinuated or notched at the base.

Odostomia minima, Jeffr. *O. clavula*, Lovén. *O. unidentata*, Mont. *O. diaphana*, Jeffr. *O. fenestrata*, Forb. *O. Humboldti*, Risso. *O. tricincta*, Jeffr.

Odostomia brevicula *, Jeffreys. (Pl. XVI. fig. 4.)

SHELL conical, solid, opaque, and glossy: *sculpture*, short, strong, straight, and rather sharp longitudinal ribs, of which there are about a dozen on the last whorl; they terminate abruptly at the periphery, which is bluntly angulated; the interstices of the ribs have an excavated appearance; under the microscope the whole surface is covered lengthwise with very fine and close-set striæ; the apex is quite smooth and polished: *colour* clear white: *spire* short: *whorls* 4 (besides the bulbous and heterostrophe embryonic nucleus), compressed, and gradually enlarging; the last is almost equal to half the spire: *suture* shallow and nearly straight; *mouth* oval, pointed at the base: *pillar* curved: *tooth* small and indistinct, tubercular, placed on the upper part of the pillar: *umbilicus* none. L. 0·1, B. 0·05.

Two specimens, more or less imperfect.

O. nitens, Jeffr. *O. acicula*, Ph. *O. nitidissima*, Mont. Besides undeterminable young and fragmentary young specimens of other species.

Pyramidella minuscula, Monterosato.

Eulima intermedia, Cantr. *E. distorta*, Deshayes, var.? A specimen is intermediate between this species, which is usually (although problematically) regarded as the eocene species, and the variety *gracilis*, which has been named *beryllina* by Monterosato. Mr. Watson, who has seen this specimen, considered it *E. intermedia*; but, independently of the greater size, the shell of the latter species is less slender and the last whorl is proportionally much larger than the other whorls. *E. subulata*, Donovan. *E. Jeffreysiana*, Brusina.

Eulima acutalis †, Jeffreys. (Pl. XVI. fig. 5.)

SHELL forming an elongated pyramid, thin, semitransparent, and very glossy: *sculpture*, none on the surface; but the periphery is encircled by a distinct keel, which gives the base an angulated appearance: *colour* clear white: *spire* long, straight, and sharp-pointed: *whorls* 7, slightly convex or rounded, gradually enlarging to the last whorl,

* Somewhat short. † Pointed.

which bulges and takes up nearly half of the spire; top whorl globular: *suture* rather straight, well defined, but not deep: *mouth* oval, acute-angled above and below; its length equals about one third of the spire: *outer lip* sharp-edged: *inner lip* inconspicuous: *pillar* short and straight: *base* somewhat flattened, imperforate. L. 0·05, B. 0·025.

Of this remarkable species ten specimens were found.

Eulima perminima *, Jeffreys. (Pl. XVI. fig. 6.)

SHELL slender, rather solid for its minute size, semitransparent, and glossy: *sculpture*, none: *colour* clear white, with a faint and irregular tinge of yellowish brown on the body-whorl: *spire* long, straight, and rather bluntly pointed: *whorls* 6–7, compressed and compact; last whorl (the mouth being placed upwards) forming nearly half the shell; first whorl semiglobular: *suture* slight, but distinct, straightish: *mouth* roundish-oval, contracted above, equal in length to one fourth of the spire: *outer lip* not very thin: *inner lip* conspicuous and reflected: *pillar* curved: *umbilicus* none. L. 0·05, B. 0·03.

Eight specimens.

This almost microscopic species differs from *E. distorta* (*Philippii*, Weinkauff) and its variety *gracilis* (*beryllina*, Monterosato) in size, being proportionally narrower throughout and having a shorter spire and smaller mouth. I have also detected the present species among my Zetlandic shells.

Natica flammulata, Requien.
Neritina viridis, L.

Family Solariidæ.

BRUGNONIA, n. gen.

SHELL globosely conical, imperforate: *pillar* angulated and spread out at its base.

The shell in different genera of this family is not always, as Woodward says in his description of *Solarium* (which he strangely placed in the *Littorinidæ*, and regarded as the only genus of the present family), "Orbicular, depressed; umbilicus wide and deep." The umbilicus is not a universal character in the *Solariidæ*. Of the hitherto known species of *Seguenzia* two have a wide umbilicus, while the typical species is imperforate. In *Solarium hybridum* (the type of Gray's genus *Philippia*) the umbilicus is reduced to a small and narrow perforation.

* Exceedingly small.

I have ventured to dedicate the above briefly described genus to my kind friend and correspondent the Abbé Brugnone, of Palermo, whose discoveries of recent and Tertiary shells in Sicily are or ought to be well known to all conchologists.

Brugnonia pulchella *, Jeffreys. (Pl. XVI. fig. 7.)

SHELL forming a depressed cone above and angulated below, moderately solid for its minute size, semitransparent, and rather glossy: *sculpture*, numerous, close-set and very fine longitudinal and spiral striæ, which, by their intercrossing, make the surface delicately and microscopically reticulated; the longitudinal striæ are flexuous; the apex is smooth: *colour* pale yellowish brown: *spire* short: *whorls* 5, slightly convex; the first 4 gradually increase in size, but the last or body-whorl is disproportionately large and takes up about three fourths of the shell; the top whorl is somewhat twisted: *suture* well defined, but not deep: *mouth* triangular, narrowish: *outer lip* rounded, thin, and sharp-edged, ending above in an acute angle where it joins the periphery, reflected at the other end: *inner lip* filmy and scarcely perceptible: *pillar* short and straight, terminating at the base in a slight and open but not channelled groove: *base* not umbilicated nor perforate. L. 0·035, B. 0·035.

Two specimens only, one of them much younger than the other and half its size.

Adeorbis exquisitus †, Jeffreys. (Pl. XVI. fig. 8.)

SHELL semispheroidal, expanding laterally, rather thin, transparent, and glossy: *sculpture*, numerous and extremely delicate curved longitudinal striæ or lines, which are crossed by equally numerous and fine spiral lines, causing a most exquisite kind of microscopic decussation; apex smooth: *colour* clear white: *spire* short and compressed, placed excentrically: *whorls* 3, convex and rounded; the last occupies four fifths of the shell; top whorl somewhat twisted: *suture* deeply excavated: *mouth* obtusely triangular: *outer lip* semicircular, sharp-edged, inflected above at its junction with the periphery, thickened below: *inner lip* attached to the periphery, and slightly folded over the base: *umbilicus* wide, deep, and semicircular. L. 0 025, B. 0·0175.

A single specimen of this remarkable and beautiful species.

* Beautiful little. † Exquisite.

Aporrhaïs Serresianus, Michaud.
Cerithium tuberculatum, L., var. *C. reticulatum*, Da C.
Triforis perversa, L.
Murex brandaris, L. *M. aciculatus*, Lamarck.
Lachesis minima, Mont.
Trophon syracusanus, L. *T. breviatus*, Jeffr.
Nassa reticulata, L. *N. pygmæa*, Lam.
Columbella scripta, L. *C. minor*, Sc.
Defrancia teres, Forb. *D. gracilis*, Mont. *D. Leufroyi*, Mich. *D. purpurea*, Mont., var.
Pleurotoma Loprestiana, Calc. *P. nuperrima*, Tiberi. *P. nebula*, Mont. *P. brachystoma*, Ph. *P. Stossichiana*, Brus. *P. clathrata*, de Serres. *P. rugulosa*, Ph. *P. costata*, Don. *P. Maravignæ*, Biv. Besides young and undeterminable specimens of other species of *Defrancia* and *Pleurotoma*.
Mitra ebenus, Lam.
Marginella secalina, Ph. *M. clandestina*, Brocchi.
Cypræa europæa, Mont.
Ringicula auriculata, Ménard.
Cylichna Jeffreysi, Weink.

*Cylichna parvula**, Jeffreys. (Pl. XVI. fig. 9.)

SHELL forming a short cylinder, rather solid for its minute size, semitransparent, and glossy: *sculpture*, numerous and very fine wavy lines of growth; the crown or apex is encircled by a thickened riblet or ridge; half-grown, and especially young, specimens exhibit a sunken spire of one or two whorls with a globular nucleus: *colour* clear white: *mouth* contracted above and in the middle, wide and rounded below: *outer lip* curved at each end, slightly projecting beyond the crown: *apex* perforated: *pillar* short, flexuous, notched at the base. L. 0·06, B. 0·03.

About 100 specimens.

This is perhaps the type of a distinct genus between *Cylichna* and *Utriculus*, which may be called *Cryptaxis*, because the spire is partly concealed. A little Madeiran shell, discovered by the Rev. Robert Boog Watson, and named by him *Utriculus tornatus* or *U. spretus*, somewhat resembles the present species, but is much larger and oval; and the spire is more visible, although sunken and partly concealed.

Utriculus globosus, Lov.
Bulla striata, Brug.

* Very small.

Scaphander lignarius, L. *S. punctostriata*, Mighels & Adams.
Philine quadrata, S. Wood.
Atlanta Peroni, Lesueur.

PTEROPODA.

Embolus rostralis, Souleyet.
Spirialis trochiformis, D'Orbigny. *S. reticulata*, D'Orb.
Cavolinia gibbosa, Rang.
Clio subulata, Quoy & Gaimard. *C. acicula*, Rang.

OSTRACODA.

Bairdia subdeltoidea, Jones.
Cythere tarentina, Baird.
—— *quadridentata*, Baird.
—— *scabra*, Münst.
Cythere Jonesi, Baird.
Cytheridea Mulleri, Bosquet.
Cytherella (1 valve).

FORAMINIFERA.

Cornuspira foliacea, Ph.
—— *coronata*, Costa.
Paucispirina contraria, D'Orb.
Biloculina elongata, D'Orb.
—— *depressa*, D'Orb.
—— *subsphærica*, D'Orb.
—— *ringens*, Lam.
Miliolina seminulum, Linn.
—— *secans*, D'Orb.
—— *asperula*, Seguenza
—— *pulchella*, D'Orb.
—— *Schreibersi*.
—— *bicornis*, D'Orb.
—— *Ferussaci*, D'Orb.
—— *trigonula*, Lam.
—— *tricarinata*, D'Orb.
—— *Candeiana*, D'Orb.
—— *oblonga*, Mont.
—— *contorta*, D'Orb.
Spiroloculina limbata, D'Orb.
—— *excavata*, D'Orb.
—— *canaliculata*, D'Orb.
Peneroplis planatus, F. & M.
Orbiculina compressa, D'Orb.
Psammosphæra fusca, Schultze.
Hyperammina elongata, Brady.
—— *vagans*, Br.
—— *ramosa*, Br.
Jaculella acuta, Br.
Rhabdammina, sp., fragments.
Rhizammina algæformis, Br.
Reophax scorpiurus, Montfort.
Haplophragmium canariensis, D'Orb.
p., allied to *globigerini-*
Ammodiscus incertus, D'Orb.
Webbina clavata, Parker & Jones.
Textularia sagittula, Defrance.
—— *trochus*, D'Orb.
Bigenerina digitata, D'Orb.
Clavulina parisiensis.
Bolivina dilatata, Reuss.
Nodosaria raphanus, L.
—— *raphanistrum*, L.
—— *bacillum*, Defr.
Dentalina obliqua, D'Orb.
—— *communis*, D'Orb.
Vaginulina legumen, L.
Marginulina glabra, D'Orb.
Cristellaria arcuata, D'Orb.
—— *rotulata*, Lam.
—— *cultrata*, Montf.
—— *italica*, Defr.
—— *reticulata*, Schwager.
Polymorphina gibba, D'Orb.
—— *lanceolata*, Reuss.
Uvigerina pygmæa, D'Orb.
Globigerina rubra, D'Orb.
—— *bulloides*, D'Orb.
Orbulina universa, D'Orb.
Sphæroidina bulloides, D'Orb.
Discorbina parisiensis, D'Orb.
Planorbulina mediterranensis, D'Orb.
—— *larvata*, P. & J.
Truncatulina lobatula, Walker.
—— *refulgens*, Montf.
Polytrema rubra, Lam.
Pulvinulina punctulata, D'Orb
—— *elegans*, D'Orb.
—— *Karstenii*, Reuss.
Rotalia Soldanii, D'Orb.
—— *Beccarii*, L.
Polystomella crispa, L.
Operculina complanata, Defr.

L.—*The Lepidoptera collected during the recent Expedition of H.M.S. 'Challenger.'* By Arthur G. Butler, F.L.S., F.Z.S., Assistant Keeper, Zoological Department, British Museum.

The Lepidoptera obtained by the naturalists of the 'Challenger' represent 101 species, distributed as follows:—

	Philippine Islands.	Aru.	Admiralty Islands.	Fiji Islands.	Friendly Islands.
Salpinx usipetes	..	*			
—— oculatus	*				
—— iphianassa	..	..	.	*	
Nacamsa Meldolæ	*				*
Calliplœa Saundersii		*			
Saphara ursula	..	.	*		*
Radena manillana	*				
Andasena Lucasii	*				
Nipara eleutho	..		..	..	*
—— Eschscholtzii	.	..		*	
Hamadryas nais	*				
Tirumala angustata	..	..	.	..	*
Salatura Edmondii	*				
—— affinis	..	*			
—— aruana	..	*			
—— chrysippus	*				
Anosia plexippus	..	..	..	..	*
Melanitis taitensis	..	..	..	..	*
Zethera musa	*				
Sevanda Duponchelii	..	*			
Mydosama æthiops	..	*			
—— phidon	.	*			
Calysisme justinella	*				
Ragadia melindena	*				
Hypocysta osyris	..	*			
Ypthima Sempera	*				
Xois fulvida	..	..	..	*	
Tenaris catops	..	*			
—— myops	..	*			
Messaras madestes	..	*			
Atella Bowdenia	..	..	..	..	*
Cethosia luzonica	*				
—— damasippe	.	*			
Cynthia deione	*				
Neptis venilia	..	*			
—— lactaria	..	*			

	Philippine Islands.	Aru.	Admiralty Islands.	Fiji Islands.	Friendly Islands.
Hypolimnas nerina	..	*			
—— lasinassa	..	*			
—— eriphile	..	..	..	*	
—— pallescens	..	..	..	*	
—— Murrayi	..	..	..	*	
—— Thomsoni	.	..	..	*	*
—— Moseleyi	..	..	..	..	*
—— Naresi	..	..	..	..	*
Precis hellanis	..	*			
—— ida	*				
Junonia villida	..	..	..	*	*
Acræa andromacha	..	..	..	*	
Sospita segecia	*				
Holochila intensa	*				
Pithecops hylas	*				
Danis aleuas	..	*			
—— coritus	..	*			
Castalius roxus	*				
Catochrysops strabo	*				
—— ancyra	..	*			
—— sp.?	..	..	..	..	*
Nacaduba aluta	*				
—— macrophthalma	*				
Jamides carissima	..	..	..	..	*
Lampides evanescens	*				
—— cleodus	*				
—— suidas	*				
Zizera orions	*				
Nilasera œnone	..	*			
Terias invida	*				
—— alitha	*				
—— diversa	*				
—— sulphurata	..	*			
—— aprica	..	..	..	..	*
—— vallivolans	*				
—— hecabe	..	*			
—— puella	..	*			
Appias domitia	*				
—— mindanensis	*				
Ornithoptera aruana	..	*			
Papilio gordion	*				
—— idæoides	*				
—— ledebouria	*				
—— Schmeltzi	..	..	..	*	
—— alcidinus	..	*			
—— emalthion	*				
Pamphila eurotas	..	*			
—— angustula	..	..	..	*	
—— sunias	*				

	Philippine Islands.	Aru.	Admiralty Islands.	Fiji Islands.	Friendly Islands.
Suastus sp.?	*				
Thanaos inornatus	..	*			
Plesioneura insulata......	..	*			
—— proserpina	..	*			
Argina cribraria	..	.	.	*	
Damalis alciphron	.	..	*		.
Hypsa dama	..	*			
Cleis aruana	..	*			
Nyctemera fasciata	..	..	..	*	
—— alternata	*				
Pitasila inconstans	*				
Cocytodes modesta	..		..	*	
Phyllodes cerasifera	*				
Azazia rubricans	.	*			
Hydrocampa sp.?	*				
Astura fluminalis	..	*.	..	*	
Number of species ...	41	35	2	15	12

The most valuable series is that collected in the Aru Islands, containing, among other species, a new *Papilio* allied to *P. Laglaizei* of Depuiset (Ann. Soc. Ent. France, 1878, p. 142, pl. v.), from New Guinea, but certainly quite distinct; it is an admirable copy of a day-flying moth, *Alcidis aruus* of Felder, particularly as regards the pattern and coloration of the upper surface; on the under surface, however, is a character which strongly supports the view, held by Messrs. Bates, Wallace, Trimen, and others, that resemblances of this kind are due to the assimilation of species in need of protection to the pattern of others which, owing to their odour, taste, or uneatable aspect, enjoy immunity from the attacks of insect-enemies. This character consists in a longitudinal orange streak, so placed upon the abdominal area of the hind wings as to simulate (when the butterfly is in repose) the orange ventral surface of the abdomen in the moth; the same character may also be seen in the figure of *P. Laglaizei*. If the *Papiliones* in repose retained the same flattened wing-surface as do the species of *Alcidis*, it is obvious that the orange streak would rather hinder than assist the resemblance between the two; it is, however, well known that the abdominal border in *Papilio* is in this position so folded that the streak would appear to be upon the body.

One must not, however, overlook one fact in connexion

with this question, and that is the fact of the apparent rarity of these copying Papilionidæ. If it be of great importance for one species to resemble another, inasmuch as that thereby the copying species shares, in common with its model, immunity from evil, one would naturally suppose that this advantage would be evidenced by abundance of specimens. It seems to me, however, that, on the other hand, if the numbers of the butterfly and moth were equal, many of the former would fall victims to the inexperience of young birds before the association of an evil taste or smell with such a type of coloration was discovered; this would quickly reduce the number of the butterfly, whilst the moth escaped. On the other hand, many of the butterflies which resemble Euplœinæ appear to be abundant; and I think we must look for the explanation of this in the abundance of examples in the species of that group, coupled with the abundance of species, all much alike, and therefore representing an army of unpalatable individuals greatly exceeding in numbers the so-called "mimicking" species.

The subfamily Euplœinæ is largely represented in the 'Challenger' collections, no less than seventeen species being referable to this group; of these, one of the most interesting to me is a species named by Mr. Moore *Tirumala angustata*, and which is represented by eighteen examples from Tongatabu; in this series there is only one variety, a melanistic example differing from the typical form in the want of the irregular spot towards the end of the cell of the front wings, but agreeing with it in every other respect. The point of interest about this species is its marvellous similarity to *T. hamata* of Australia, and nevertheless the absolute constancy of the principal character by which it can be distinguished, the dark brown band on the hind wings, separating the greenish-white markings of the basal area from the inner series of spots upon the external area, being invariably about half as wide in *T. angustata* as in *T. hamata*. I regard the constancy of the slight differences in these two locally separated but nearly allied forms as important evidence against those who assume that all differences of pattern which do not at once arrest attention are due to individual variation, and who consequently must not only be themselves disabled from studying the geographical distribution of species in its finer details, but must deter others from learning the exact truths which a study of it is designed to teach.

Another interesting form in which the characters are also constant, though equally slight, is *Saphara ursula*, a species of the same subfamily, to which I shall have to call attention later in this paper.

List of the Species.

Rhopalocera.

Nymphalidæ.

Euplœinæ.

This subfamily is represented by seventeen species, one of which, however, may, I think, eventually prove to be a a slightly melanistic form of *Salatura affinis*, inasmuch as both forms are in the same series from Aru (possibly not from the same island); at the same time I prefer to regard them as distinct, until proofs of their identity have been produced. Seven of the species are pronounced by Mr. Moore to be new; six of these are included in the revision of the subfamily prepared by Mr. Moore, the seventh, however, appears not to be described by him.

1. *Salpinx usipetes.*

Euplaa usipetes, Hewitson, Exot. Butt. ii. *Eupl.* pl. i. fig. 4 (1858).

Two males. "Dobbo (Wamma), Wanumbai, Wokan, Aru Island."

The localities above given were upon the box containing the Aru specimens, the exact locality not being recorded upon the envelopes; I shall therefore refer to them simply as from Aru.

2. *Salpinx oculatus.*

Salpinx oculatus, Moore, Rev. Eupl. P. Z. S. 1883.

♂. Pasananca valley, Mindanao, near Zamboanga, February 1875.

3. *Salpinx iphianassa.*

Euplœa iphianassa, Butler, P. Z. S. 1866, p. 287. n. 57, pl. cclxxxvi fig. 3.

♀. Kandavu, Fiji, August 1874.

4. *Nacamsa Meldolæ.*

Nacamsa Meldolæ, Moore, Rev. Eupl. P. Z. S. 1883.

♂. Pasananca valley, Mindanao, near Zamboanga, February 1875.

This species was represented in the collection by only one example; it is an admirable copy of *Andasena Lucasii*, which came with it.

5. *Calliplœa Saundersii.*

Euplœa Saundersii, Felder, Reise der Nov. Lep. ii p. 322. n. 439 (1867).

♂. Aru.

6. *Saphara ursula*, sp. n.

Allied to *S. Treitschkei* of New Ireland, *biformis* of Duke-of-York Island, and *ænea* of the Solomon Islands; but differing constantly from all three (in both sexes) in having two unequal subapical white spots on the upper surface of the primaries, and no spot on the first median interspace, the two upper spots of the triangular group in *S. Treitschkei* being alone present; the interno-median elongated spot is considerably smaller and shorter than in any of the species; the first three of the discal series of spots on the secondaries of the female are generally much enlarged, and two of them are frequently present on the male secondaries. In the dark blue-black colouring of the male the species most nearly approaches *S. biformis*; but the pattern of the under surface (with the exception of the subapical spots on the primaries) agrees with *S. Treitschkei*. Expanse of wings 84–95 millim.

Ten specimens. "Dentrecasteaux Island, Admiralty Group"*.

It is evident that each island, or at least each group of islands, has a separate species, constantly differing, although in apparently insignificant characters, from its nearest allies. To those who have not specially studied the Euplœinæ the presence or absence of two white spots on the primaries would appear to be a variation scarcely worthy of remark, much less of specific value; nevertheless it is perfectly clear that the form having these spots is characteristic of the island where it occurs, and therefore to record one of the Admiralty Islands as a locality for *S. Treitschkei* would not be in accordance with exact scientific fact. We might say that a local form of the latter species was found in the Admiralty group, a second in the Solomon group, and a third at Duke-of-York Island; but the rapid increase of our collections of Lepidoptera proves more and more clearly that the genera consist of nothing but gradational series of local forms in this Order; and therefore, if we call the species local forms, we may call the genera species. To such a course no living Lepidopterist would consent.

7. *Andasena Lucasii.*

Andasena Lucasii, Moore, Rev. Eupl. P. Z. S. 1883.

Four males. Pasananca valley, Mindanao, near Zamboanga, February 1875.

* See H. N. Moseley's 'Naturalist on the Challenger,' p. 454.

8. *Nipara eleutho.*

Danais eleutho, Quoy, Freyc. Voy. pl. lxxxiii. fig. 2 (1815).

Tongatabu, 20th July 1874.

9. *Nipara Eschscholtzii.*

Euplœa Eschscholtzii, Felder, Reise der Nov. Lep. ii. p. 345. n. 480 (1867).

Kandavu, Fiji.

10. *Hamadryas nais.*

Nymphalis nais, Guérin, Voy Coq. pl. xv. fig. 3 (1829).

Aru.

11. *Radena manillana.*

Radena manillana, Moore, Rev. Eupl. P. Z. S. 1883

Camiguen, Philippines, 26th January 1875; Pasananca valley, Mindanao, February 1875.

12. *Tirumala angustata.*

Tirumala angustata, Moore, Rev. Eupl. P. Z. S. 1883

♂ ♀. Eighteen examples. Tongatabu, July 1874.

13. *Salatura Edmondii.*

Danais Edmondii, Bougainville, Voy. Thetis, pl. xliv. figs 3, 3 *bis* (1837)

♂ ♀. Six specimens. Pasananca valley, Mindanao, February 1875.

14. *Salatura affinis.*

Papilio affinis, Fabricius, Syst. Ent. p. 511. n. 291 (1775).

♂ ♀. Five specimens. Aru.

15. *Salatura aruana.*

Salatura aruana, Moore, Rev. Eupl. P. Z. S. 1883.

♂ ♀. Three specimens. Aru.

16. *Salatura chrysippus.*

Papilio chrysippus, Linnæus, Mus. Lud. Ulr. p. 263 (1764).

Pasananca valley, Mindanao, February 1875.

17. *Anosia plexippus.*

Papilio plexippus, Linnæus, Mus. Lud. Ulr. p. 262 (1764).

Tongatabu, July 1874.

Satyrinæ.

18. *Melanitis taitensis.*

Cyllo leda, var. *taitensis*, Felder, Verh. zool.-botan. Gesellsch. xii. p. 493. n. 186 (1862).

Tongatabu, July 1874.

19. *Zethera musa.*

Zethera musa, Felder, Wien. ent. Monatschr. v. p. 301. n. 16 (1861); Reise der Nov. Lep. iii. pl. liv. figs. 6, 7 (1867).

♂ ♀. Pasananca valley, Mindanao, February 1875.

Z. aganippe of Felder, figured on the same plate (fig. 3), appears to me to be the female of *Z. musa.* The sexes in this genus are very dissimilar.

20. *Sevanda Duponchelii.*

Satyrus Duponchelii, Guérin, Voy. Coquille, pl. xvii. fig. 3 (1829).

Aru.

Although Guérin quotes this himself as a synonym of Boisduval's *Mycalesis dorycus*, and gives the locality Dorey in the letterpress, his figure does not agree with that species, but with the Aru form, which differs in the obsolete character of the orange patch on the primaries, in the absence of the blackish border to the secondaries above, and in having the primaries below ochreous instead of smoky brown; the secondaries of the Aru form also only show four ocelli on the under surface, the second of *S. dorycus* not being present. In Moore's paper on the Lepidoptera referred to *Mycalesis* (Tr. Ent. Soc. 1880, pp. 155–177), I see that Aru is given as one of the localities for *S. Duponchelii*; this habitat was doubtless obtained from Hewitson's paper in the 'Journal of the Linnean Society,' viii. p. 145 (1865), where the following additional localities are also given:—"Waigiou, New Guinea, Mysol." Felder also gives New Guinea as the locality for his *Mycalesis getulia*, quoted by Moore as a synonym.

An examination of Hewitson's series seems clearly to show that *S. Duponchelii*, *S. dorycus*, and *S. getulia* are distinct although closely allied species (or local races, if that name be considered preferable), which could readily be distinguished if one possessed a fair series from each locality, but (as in many other instances) which look like slight varieties when single specimens from each locality are alone retained. Hewitson only possessed a single female from Dorey; and we possess three males from that locality. These are all uniform in the dark border to the secondaries above, the pale under

surface of the primaries, and the more numerous ocelli on the secondaries (*S. dorycus*); Hewitson also had a male from Mysol and a female from New Guinea, more nearly approaching *S. Duponchelii*, the secondaries having two strongly marked black marginal lines, somewhat obscured with brown in the male, and the under surface of the primaries dark, though not so dark as in the Aru form, the secondaries without the second ocellus (*S. getulia*). A male from Waigiou and a pair from Aru in Mr. Hewitson's collection appear to belong to a third form, the typical *S. Duponchelii*, although the males differ slightly from each other in the form of the submarginal lines on the secondaries; both, however, are destitute of the orange patch below the second ocellus on the primaries, which in the female is reduced to a slender curved streak partly encircling the ocellus; and all agree in other respects with the Aru specimen before me. I should therefore propose that these forms should be kept separate, thus:—

1. *Sevanda Duponchelii*, Guér. Aru, Waigiou.
2. *Sevanda getulia*, Feld. New Guinea, Mysol.
3. *Sevanda dorycus*, Boisd. Dorey.

21. *Mydosama æthiops.*

Mycalesis æthiops, Butler, Cat. Sat. B. M. p. 141, pl. iii. fig. 11 (1868).

Aru.

22. *Mydosama phidon.*

Mycalesis phidon, Hewitson, Exot. Butt. iii. p. 84, *Myc.* pl. iii. fig. 16 (1862).

Aru.

23. *Calysisme justinella.*

Mycalesis justinella, Butler, Cat. Sat. B. M. p. 135, pl. iii. fig. 12 (1868).

Pasananca valley, Mindanao, February 1875.

24. *Ragadia melindena.*

Ragadia melindena, Felder, Wien. ent. Monatschr. vii. p. 125. n. 99 (1863).

Pasananca valley, Mindanao, February 1875.

25. *Hypocysta osyris.*

Satyrus osyris, Boisduval, Voy. Astrolabe, Lép. p. 154. n. 17 (1832).

Aru.

26. *Ypthima sempera.*

Yphthima sempera, Felder, Wien. ent. Monatschr. vii. p. 125. n. 98 (1863).

Camiguen, Philippines, 26th January 1875; Mindanao, February 1875.

27. *Xois fulvida*, sp. n.

Allied to *X. sesara*, but differing constantly in the ochraceous colour of the primaries and the border of the secondaries, also in the discoidal cell of primaries not being dusky excepting at the base, and the narrowness of the dusky external border of these wings; secondaries below rather paler than in *X. sesara*. Expanse of wings 34–38 millim.

Banks of the Wai Levu, Viti Levu, and Kandavu, Fiji, 2nd August 1874.

I have before me eight examples in better or worse condition, and the same number of specimens of *S. sesara*; so that I have no doubt about the constancy of the characters by which these two forms are distinguished.

Morphinæ.

28. *Tenaris catops.*

Drusilla catops, Westwood, Gen. Diurn. Lep. p. 335. n. 3, note (1851)

♂ ♀. Aru.

29. *Tenaris myops.*

Drusilla myops, Felder, Wien. ent Monatschr. iv. p. 100. n. 68, pl. i. fig. 1 (1860).

♂ ♀. Aru.

Very closely allied to *T. dioptrica* of Vollenhoven.

Nymphalinæ.

30. *Messaras madestes.*

Messaras madestes, Hewitson, Ex. Butt. ii. *Mess.* pl. i. figs. 3, 6 (1859).

Aru.

31. *Atella Bowdenia.*

Atella Bowdenia, M. R. Butler, P. Z. S. 1873, p. 687.

Tongatabu, July 1874.

32. *Cethosia luzonica.*

Cethosia luzonica, Felder, Wien. ent. Monatschr. vii. p. 107. n. 68 (1863).

Pasananca valley, Mindanao, February 1875.

33. *Cethosia damasippe.*

Cethosia damasippe, Felder, Reise der Nov. Lep. iii. p. 379. n. 550 (1867).

Aru.

This example differs somewhat from one which we have from Dorey; but as we only have a single specimen in each case, and the description by Felder embraces both forms, it would be rash at present to regard them as distinct; at the same time, judging from the absolute constancy of the nearly allied *C. imperialis* from Queensland, it seems highly probable that they are so.

34. *Cynthia deione.*

Cynthia deione, Erichson, Nova Acta Ac. Nat Cur. xvi. Suppl. pl. 50. figs. 2, 2 *a* (1833).

Pasananca valley, Mindanao, February 1875.

The specimens of this species were much shattered, as though they had been long on the wing.

35. *Neptis venilia.*

Papilio venilia, Linnæus, Mus. Lud. Ulr. p. 290 (1764)

Aru.

The Aru specimens differ slightly in the broader white band of the primaries from those occurring at Amboina, Ceram, Mysol, and Waigiou.

36. *Neptis lactaria.*

Athyma lactaria, Butler, Ann. & Mag. Nat. Hist. ser. 3, vol. xvii. p. 98. n. 1 (1866).

Aru.

Only a single specimen of each of the preceding species was obtained.

37. *Hypolimnas nerina.*

♀. *Papilio nerina*, Fabricius, Syst. Ent. p. 509. n. 277 (1775).

♀. Aru.

H. auge of Cramer is the male of the Javan form.

38. *Hypolimnas lasinassa.*

♂. *Papilio lasinassa*, Cramer, Pap. Exot. ii. pl. ccv. A, B (1779).

♂. Aru.

The female of this is figured by Cramer as *P. manilia.*

39. *Hypolimnas eriphile?*

♀. *Papilio eriphile*, Cramer, Pap. Exot. iv. pl. ccclxxxvi. A, B (1782).

♀. Kandavu, Fiji.

This is somewhat smaller than Cramer's figure; and the subapical white band of the primaries is frequently obscured. It

may possibly be a dark variety of the following species, and not identical with that from Amboina.

40. *Hypolimnas pallescens.*

♀. *Diadema pallescens*, Butler, P. Z. S. 1874, p. 282. n. 47.
Diadema bolina, var., Butler, Brenchley's 'Cruise of the Curaçoa,' p. 468, pl. xlviii. figs. 3, 4 (1873).

♂ ♀. Kandavu, Fiji.

The specimens of this and the preceding form are all much shattered; they had probably been long on the wing when captured.

41. *Hypolimnas Murrayi*, sp. n.

♂. Upper surface velvety black; primaries with a trifid rather narrow lilacine patch, sprinkled with white scales and placed upon a reniform ultramarine field beyond the cell; three subapical white spots, the upper two large and only divided by the upper furcation of the subcostal vein: secondaries with a large central lilacine patch, sprinkled with white and broadly encircled with ultramarine blue. Below smoky brown, darker on the disk excepting towards apex of primaries; these wings with the cell mahogany-red, with the usual black-bordered white spots; an oblique narrow opaline-white band of five spots just beyond the cell; subapical white spots as above, but continued by a series of five other spots with bluish edges; median interspaces black; a submarginal series of pale brown and lilacine lunate spots in pairs followed by a series of simple whitish linear crescents: secondaries with a narrow slightly tapering white band commencing just above the subcostal vein and divided by the nervures; two white spots just beyond its inferior extremity, bordering the anal excision of the abdominal margin; a white subcostal spot beyond the central band; a discal series of six blue-edged white spots almost parallel to the outer margin; submarginal markings as on the primaries, but white. Expanse of wings 83 millim.

♀. Larger than the male, the outer margin of the primaries more excavated as usual, the lilacine patch replaced by a quadrifid greyish band corresponding with that of the under surface; the white discal spots and submarginal markings visible above, more so on the primaries than on the secondaries; the latter wings with the lilacine patch elongated, crossed by black veins; no ultramarine blue on the wings: under surface a little paler than in the male, the submarginal markings of primaries white, as on the secondaries; the oblique band on the primaries and the tapering band and

subcostal spot on the secondaries a little greyer, and therefore not quite so prominent as in the male. Expanse of wings 100 millim.

Kandavu, Fiji.

Only a pair of this species was obtained: it comes nearest to *H. perimele* of Cramer.

42. *Hypolimnas Thomsoni*, sp. n.

Allied to the preceding species, smaller in both sexes; the male with the lilacine patch of primaries less oblique, and that of secondaries smaller; the band beyond the cell on the female is also pure white and quadrifid; the discal series of white spots on the upper surface of the female also stops short on the second median interspace, and the submarginal markings are very indistinct; the lilacine patch on the secondaries is semicircular and has a narrow but distinct ultramarine edge: on the underside the red colouring in the cell of primaries is duller, more diffused; the submarginal markings in the male are obliterated, and in the female are blurred; the white band on the secondaries is obliterated in both sexes, but the subcostal spot is present, as also are the small spots on the disk. Expanse of wings, ♂ 74 millim., ♀ 93 millim.

♂. Tongatabu; ♀. Kandavu.

43. *Hypolimnas Moseleyi*, sp. n.

Also allied to *H. Murrayi*, slightly smaller; the male with the lilacine patch of primaries smaller, transversely cuneiform, that of secondaries large and irregularly pentagonal; the band beyond the cell in the female pure white, opaline, with ultramarine margin, quinquefid; the discal spots distinct on the primaries, the submarginal markings about the same, but no trace of discal spots or submarginal markings on the upper surface of the secondaries; the lilacine patch on these wings similar in form and diffused, but broadly encircled with ultramarine blue, as in the male. Wings below more olivaceous than in *H. Murrayi*, the submarginal double lunate spots narrower, and band of secondaries in both sexes only represented by a diffused whitish central patch and an indistinct streak of pale scales from it to the abdominal border. Expanse of wings, ♂ 74 millim., ♀ 90 millim.

Five examples. Tongatabu, July 1874.

44. *Hypolimnas Naresi*, sp. n.

Also allied to *H. Murrayi*, much smaller; the male with the lilacine patch of primaries narrower, trifid, curved, and

that of secondaries a little smaller; the band beyond the cell in the female pure white, opaline, with ultramarine margin, less oblique than in *H. Moseleyi*; the discal series of spots not extending beyond the first median interspace, the uppermost (subapical) bifid spot yellowish; those of secondaries and the submarginal markings on all the wings obsolete; lilacine patch of secondaries unusually white, surrounded with ultramarine blue. Under surface more olivaceous in the male, almost sandy yellowish in the female, the red in the discoidal cell dull; submarginal lunate markings narrow, indistinct, and pale brown, excepting near the posterior angles of the wings, where they are a little more distinct; band of secondaries only represented by a central streak of excised white spots separated by the nervures. Expanse of wings, ♂ 74 millim., ♀ 81 millim.

♂, var. Wings below very dark, submarginal markings wholly obselete. Expanse of wings 68 millim.

Fourteen examples. Tongatabu, July 1874.

The obscurity of the submarginal markings and usually smaller size of this species readily separate it from *H. Moseleyi*; most of the specimens were a good deal shattered, two pairs only being in fair condition.

45. *Precis hellanis.*

Precis hellanis, Felder, Reise der Nov. Lep. iii. p. 402 n. 601 (1867).

Aru.

46. *Precis ida.*

Papilio ida, Cramer, Pap. Exot. i. pl. xlii. C, D (1776).

Camiguen and Mindanao, Philippines.

47. *Junonia villida.*

Papilio villida, Fabricius, Mant. Ins. ii. p. 35. n. 366 (1787).

Tongatabu, July 1874; banks of Wai Levu, Viti Levu; Kandavu, Fiji, 2nd August 1874.

Acræinæ.

48. *Acræa andromacha.*

Papilio andromacha, Fabricius, Syst. Ent. p. 466. n. 102 (1775).

Kandavu, Fiji, August 1874.

Lemoniidæ.

49. *Sospita segecia.*

Sospita segecia, Hewitson, Ex. Butt. ii. *Sosp.* pl. i. figs. 4–6 (1861).

♂ ♀. Aru.

The two examples obtained have evidently been long on the wing.

Lycænidæ.

50. *Holochila intensa.*

Holochila intensa, Butler, Ann. & Mag. Nat. Hist. ser. 4, vol. xviii. p. 245. n. 20 (1876).

♀. Aru.

51. *Pithecops hylus.*

Papilio hylas, Fabricius, Syst. Ent. p. 526. n. 351 (1775).

Pasananca valley, Mindanao.

52. *Danis alenas.*

♂. *Lycæna alenas*, Felder, Reise der Nov. Lep. ii. p. 268. n. 325, pl. xxxiii. figs. 15, 16 (1865).

♂. Aru.

53. *Danis coritus.*

Polyommatus coritus, Guérin, Voy. Coq. ii. pl. xviii. fig. 3 (1829).

♀. Aru.

54. *Castalius roxus.*

Polyommatus roxus, Godart, Enc. Méth. ix. p. 659. n. 142 (1823).

Pasananca valley, Mindanao.

55. *Catochrysops strabo.*

Hesperia strabo, Fabricius, Ent. Syst. iii. 1, p. 287. n. 101 (1793).

Pasananca valley, Mindanao.

56. *Catochrysops ancyra.*

♂. *Lycæna ancyra*, Felder, Reise der Nov. Lep. ii. p. 276. n. 342, pl. xxxiv. fig. 5 (1867).

♂. Aru.

The species is near to *C. complicata*, but larger; Felder described it from an example taken in Amboina.

57. *Catochrysops*, sp.?

A small grey-brown species, perhaps *C. caledonica* of Felder much rubbed and faded; it is of the same size, and the markings, so far as I can trace them, appear to be the same.

Tongatabu, July 1874.

There is also in the collection a fragment from Aru which may either belong to this or the following genus.

58. *Nacaduba aluta.*

Cupido aluta, Druce, P. Z. S. 1873, p. 349. n. 16, pl. xxxii. fig. 8.

Pasananca valley, Mindanao.

59. *Nacaduba macrophthalma.*

Lycæna macrophthalma, Felder, Reise der Nov. Lep. ii. p. 275. n. 339, pl. xxxiv. fig. 35 (1867).

Pasananca valley, Mindanao.

60. *Jamides carissima.*

Lampides carissima, Butler, P. Z. S. 1875, p. 615. n. 24, pl. lxvii. figs. 4, 5.

Tongatabu, July 1874.

61. *Lampides evanescens.*

Lampides evanescens, Butler, P. Z. S. 1875, p. 615. n. 26.

♀. Camiguen, Philippine Islands.

A single much worn example.

62. *Lampides cleodus.*

Lycæna cleodus, Felder, Reise der Nov. Lep. ii. p. 272. n. 334, pl. xxxiv. figs. 20–22 (1867).

Pasananca valley, Mindanao, near Zamboanga.

The silvery greenish-white tint of this species is not well shown in Felder's figures.

63. *Lampides suidas*?

♂. *Lycæna suidas*, Felder, Reise der Nov. Lep. ii. p. 273. n. 335, pl. xxxiv. figs. 18, 19 (1867).

♀. Pasananca valley, Mindanao.

Apparently the female of Felder's species, but decidedly whiter.

64. *Zizera oriens*, sp. n.

♂. Allied to *Z. pygmæa* of Snellen; larger, lilacine blue

above; the apical area and external border of primaries brown, the base of costa whitish: secondaries with the costal border broadly and the external border narrowly brown, base blackish blue; abdominal border white, sericeous, with slightly cupreous reflections; markings much as in *Z. pygmæa*, but the marginal and submarginal markings less distinct, and the series of small black spots across the disk of primaries forming an almost straight line. Expanse of wings 24 millim.

Pasananca valley, Mindanao.

A very ragged and broken example, perhaps the female of the above, is in the Camiguen series; it appears to have been of a smoky brown tint, sprinkled with bluish scales on the surface; but it is so much injured that it may even belong to a distinct species.

Z. oriens is as large as *Z. maha* of Kollar.

65. *Nilasera æxone*.

Amblypodia æxone, Hewitson, Ill. Diurn. Lep. p. 5, n. 15, pl. iii. figs. 20, 24 (1863).

♀. Aru.

Papilionidæ.

Pierinæ.

66. *Terias invida*, sp. n.

♂. Gamboge-yellow, with almost the pattern of *T. alitha* and *T. Lorquinii*, the costal margin being narrowly black-brown; the apical area broadly (with oblique slightly concave inner edge), the outer margin rather broadly black-brown, but only separately represented on the median interspaces, where (as usual) its inner edge is bisinuated; inner border broadly edged with black-brown, the anterior margin of this border being distinctly sinuated before the middle: secondaries with a broad external border, gradually narrowing towards the apex, and with the inner edge regularly sinuated from first median branch to apex; a basal black-brown spot. Wings below as usual—that is to say, paler than above, and with the markings of *T. hecabe*. Expanse of wings 40 millim.

♀. Primrose-yellow, with almost the pattern of the male, but paler; the inner border of primaries not sinuated, and the inner edge of the outer border of secondaries quite regular, without a trace of sinuation. Wings below similarly marked to those of *T. æsiope*. Expanse of wings 34 millim.

Pasananca valley, Mindanao.

This species is very near to the following, but much smaller, and with the inner or anterior edge of the inner border of the primaries distinctly sinuated; this, I believe, is not an individual variation, but characteristic of the smaller species, and is the first indication of a step in the direction of the *T. hecabe* group, in which this border is very much abbreviated or wholly missing.

An arrangement of the species of the present group to show gradation to *T. hecabe* would be as follows:—

1. *T. celebensis*, Wall.; 2. *T. tominia*, Voll.; 3. *T. zama*, Feld.; 4. *T. zita*, Feld.; 5. *T. rahel*, Fabr. (=? *T. sinensis*, Luc.); 6. *T. Lorquinii*, Feld.; 7. *T. alitha*, Feld.; 8. *T. invida*, Butl.; 9. *T. tilaha*, Horsf.; 10. *T. eumede*, Feld.; 11. *T. hecabe*, Linn.

There is, however, a distinct break between the two groups; and this makes the suggestion (Trans. Ent. Soc. 1882, p. 489) that one of the most heavily bordered of them is a variety of *T. hecabe*, the more preposterous. Of the eleven forms associated by Pryer, five only occur in Japan; and of these two are admitted hybrids. *T. hecabe* itself is Chinese; *T. hecabeoides* and *T. æsiope* are Himalayan; *T. brenda* strictly African; *T. sari*, Malayan, having never been taken excepting in Java, Borneo, and Malacca: these species also belong to five different sections of the genus, some of which (as shown above) approach nearly to one another, but without actually running together; thus *T. brenda* belongs to the same section with *T. solifera* and *T. senegalensis*, a section characterized by its white or whitish females; it is strictly African, no species being known from any other part of the world. Next to this comes the *T. hecabe* group, in which the females are sulphur-yellow; thirdly, the *T. æsiope* group, readily distinguished from both the preceding (and from any *Terias* found in Japan) by the irregularly sinuous transverse subapical red-brown streak on the under surface of the primaries; fourthly, we have the *T. sari* group, in which the sinuation of the outer border of primaries is distinctly oblique and the apical area of these wings below is occupied by a large quadrate reddish chocolate patch; and lastly the *T. tilaha* group, to which the more heavily bordered *T. sinensis* belongs, and which is characterized by the black or black-brown internal border to the primaries.

67. *Terias alitha.*

Terias alitha, Felder, Wien. ent. Monatschr. vi. p. 289. n. 51 (1862).

♂ ♀. Pasananca valley, Mindanao.

68. *Terias diversa.*

Terias diversa, Wallace, Trans. Ent. Soc. ser. 3, vol. iv. p. 324. n. 20 (1867).

♂ ♀. Camiguen, Philippines.

69. *Terias sulphurata.*

Terias sulphurata, Butler, P. Z. S. 1875, p. 617. n. 32.

♂. Aru.

70. *Terias aprica*, sp. n.

♂. Upper surface as in the preceding species; gamboge-yellow: primaries with slender black costal margin; apical area black-brown, commencing at apical third of costa, its inner edge oblique and concave, with four shallow sinuations, terminating in a nearly right angle upon the third median branch; external border rather narrow, bisinuated on the median interspaces, below which it expands abruptly, becoming as wide as the lower edge of the apical area: secondaries with slender greyish margin and small black spots at the extremities of the veins. Wings below lemon-yellow, with faint traces of the usual dark brown markings on the basal half, but with no trace of the sigmoidal subapical streak of *T. sulphurata*; marginal points extremely minute. Expanse of wings 42 millim.

♂. Tongatabu.

This species is slightly larger than the preceding, from which, however, it may chiefly be distinguished by the almost immaculate under surface and the total absence of the characteristic subapical sigmoidal streak on the under surface of the primaries; it belongs in fact to the same group with *T. hecabe*, and not with *T. æsiope*.

71. *Terias vallivolans*, sp. n.

Bright lemon-yellow; primaries with the costal margin very narrowly black; apical area commencing at about the apical third of costa, its inner edge inangled and irregular, terminating in a rectangle on the third median branch; outer border upon the median interspaces narrow, unevenly bisinuated, expanding below the first median branch, but not very greatly, and notched just above the submedian vein: secondaries with a narrow, abbreviated, tapering, internally sinuated external dark brown border, commencing at the extremity of the first subcostal branch, but barely traceable beyond the second median branch. Under surface slightly paler; margin

and fringe dotted with black, the margin at the extremities of the veins, and the fringe at the extremities of the internervular folds: primaries with the usual discoidal dark brown markings in outline; secondaries with the usual squamose brown markings. Expanse of wings 43 millim.

♂. Pasananca valley, Mindanao.

In pattern and coloration nearest to *Terias Mariesii*, var. *e* (Trans. Ent. Soc. 1880, pl. vi. fig. 5), but with narrower wings, the primaries with straighter costal margin and more rounded apex, the apical area with more angular inner edge, the outer border narrower on all the wings, that of secondaries as in my fig. 6, and that of primaries not produced along the inner border, as in *T. Mariesii*.

72. *Terias hecabe.*

Papilio hecabe, Linnæus, Mus. Lud. Ulr. p 249 (1764).

♂. Aru.

73. *Terias puella.*

Xanthidia puella, Boisduval, Voy. Astr. Lép. p. 60, pl. ii. fig. 8 (1832).
Terias virgo, Wallace, Trans. Ent. Soc. ser. 3, vol. iv. p. 328. n. 35 (1867).

♂ ♀. Aru.

Boisduval's figure agrees well with Aru specimens of the male.

74. *Appias domitia.*

Pieris domitia, Felder, Wien. ent. Monatschr. vi. p. 285 n. 41 (1862).

♂. Pasananca valley, Mindanao.

75. *Appias mindanensis*, sp. n.

Tachyris domitia (part.), Semper (nec Felder), Stett. ent. Zeit. 1875, p. 401.

♂. Bright reddish orange, the veins black, the outer margins, the apical border of primaries, and the anal border of secondaries broadly greyish: primaries below deep cadmium-yellow, crossed beyond the middle by a squamose interrupted transverse grey streak; veins beyond the middle black: secondaries bright golden cadmium-yellow, a rather broad discal grey-brown band from the second subcostal to the first median branch, beyond which band the veins are black; abdominal border at base sulphur-yellow. Expanse of wings 72 millim.

♂. Pasananca valley, Mindanao.

I cannot agree with Semper in his belief that this and the

preceding are varieties of one species; nor can I admit, without further evidence than the statement of his collector as to a single pair taken by him *in copulâ*, that *A. zamboanga* and *A. asterope* are both females of *A. domitia*. If one of these prove to be the female of *A. domitia*, it will be sufficiently curious, since the males of the two nearly allied species *A. nero* and *A. figulina* have females only differing from themselves in the presence of black borders to the wings and a broken black band on the primaries. Of these sexes there can be no question, though as species they differ in characters less marked than those existing between *A. domitia* and *A. mindanensis*—both also occurring commonly at Malacca, as the latter species do in Mindanao: the females, although less common than the males, agree with them in tint and in under-surface characters; both are marked with black above, as in my figure of *A. figulina*.

Now, if M. Semper still believes *A. zamboanga* (not to mention *A. asterope*) to be the true female of *A. domitia*, he must (holding the views which he has expressed as to the variability of that species) admit, at any rate, the total distinctness of *A. nero*, and obliterate from his paper the following words:—"Mehr Licht hierüber kann erst das Bekanntwerden des ♀ von Nero Fabr. geben, wofür ich *figulina* Butler, von der ich kürzlich im Neuchâteler Museum ein Exemplar ohne Abdomen gesehen habe, nicht halten kann;" since he will certainly regard *A. figulina* as only a vermilion-coloured and more heavily banded form of the blood-red *A. nero*.

Papilioninæ.

76. *Ornithoptera arruana.*

Ornithoptera arruana, Felder, Wien. ent. Monatschr. iii. p. 391. n. 32 (1859).

♀. Aru.

77. *Papilio gordion.*

Papilio gordion, Felder, Reise der Nov. Lep. i. p. 66. n. 50 (1865).

Pasananca valley, Mindanao.

78. *Papilio idæoides.*

Papilio idæoides, Hewitson, Exot. Butt. i. *Orn. & Pap.* pl. i. fig. 2 (1855).

Pasananca valley, Mindanao.

79. *Papilio Ledebouria.*

Papilio Ledebouria, Eschscholtz, Kotzeb. Reise, iii. p. 206, pl. iii. fig. 7 (1821).

Pasananca valley, Mindanao.

80. *Papilio Schmeltzi.*

Papilio Schmeltzi, Herrich-Schaffer, Stett. ent. Zeit. 1869, p. 78. n. 57, pl. i. fig. 1; Auss. Schmett. ii. fig. 106 (1869).

Kandavu, Fiji.

81. *Papilio alcidinus*, sp. n.

Allied to *P. Laglaizei* from New Guinea (Ann. Soc. Ent. France, 1878, pl. v.), but differing as follows:—The bands above greener, the central band of primaries of more equal width throughout, more angular and less oblique, so that its lower extremity is well separated from the external angle; subapical band broader, more angular, well divided from the costa; secondaries with the greenish area wider, divided by a broad uninterrupted black belt, with its outer edge towards apex zigzag; no submarginal black spots; tail longer: primaries below with the black belt bounding the subapical white band broader and continuous with the external black border, which is also broader, and not undulated as in *P. Laglaizei*; secondaries with the orange abdominal streak longer, tapering towards the base; inner discal series of black spots larger, six (instead of four) in number; the black submarginal lunules between the tail and the anal angle separate, not united into a wavy stripe as in *P. Laglaizei*. Expanse of wings 112 millim.

Aru.

An exact copy on the upper surface of *Alcidis aruus* of Felder.

82. *Papilio emalthion.*

Iliades emalthion, Hubner, Samml. exot. Schmett. (1816–36).

♀. Mindanao.

Hesperiidæ.

83. *Pamphila eurotas.*

Pamphila eurotas, Felder, Sitzb. Ak. Wiss. math.-nat. Cl. xl. p. 461. n 52 (1860).

♂. Aru.

84. *Pamphila angustula.*

Pamphila angustula, Herrich-Schäffer, Stett. ent. Zeit. 1869, p. 70. n. 58.

Fiji; banks of the Wai Levu, Viti Levu.

85. *Pamphila sunias.*

Pamphila sunias, Felder, Sitzb. Ak. Wiss. math.-nat. Cl. xl. p. 462. n. 54 (1860).

Camiguen, Philippines, 26th January 1875.

86. *Suastus*, sp. n.?

Allied to *S. gremius*, Fabr., but too much rubbed and broken to form the type of a new species.

Mindanao.

87. *Thanaos inornatus*, sp. n.

♂. Above dark olive-brown, with slight cupreous reflections; body darker than the wings. Palpi below sordid whitish: primaries below smoky brown, slighly paler towards the inner margin; apical area diffused lilacine greyish: secondaries lilacine, irrorated with smoky brown, especially towards the base: body below grey. Expanse of wings 33 millim.

Aru.

88. *Plesioneura insulata.*

Plesioneura insulata, Butler, Ann. & Mag. Nat. Hist. ser. 5, vol. x. p. 154. n. 31 (1882).

Aru.

89. *Plesioneura proserpina*, sp. n.

Allied to *P. alysos* of Ceylon; black-brown; primaries crossed obliquely in the middle from costa to submedian vein by a broad semihyaline white belt, its inner edge angulated at the first median branch and its outer edge at the third median; five small white spots in a subapical zigzag series; under surface slightly paler, the palpi and a ventral longitudinal stripe white. Expanse of wings 42 millim.

Aru.

The two preceding species belong to the same group in the genus; but the differences are well marked and appear to be constant. A form very close to *P. proserpina* occurs at Waigiou.

Heterocera.

Lithosiidæ.

90. *Argina cribraria.*

Phalæna cribraria, Clerck, Icones, tab. 54. figs. 4, 4 *a* (1759–64).

Matuku, Fiji, July 24th 1874.

91. *Damalis alciphron.*

Phalæna-Attacus alciphron, Cramer, Pap. Exot. ii. p. 58, pl. cxxxiii. fig. E (1779).

Wild Island, Admiralty group.

92. *Hypsa dama.*

Noctua dama, Fabricius, Sp. Ins. ii. p. 216. n. 39 (1781); Donovan, Ins. New Holl. pl. xxxix. fig. 1 (1805).

Aru.

93. *Cleis aruana.*

Cleis aruana, Butler, Ann. & Mag. Nat. Hist. ser. 4, vol. xix. p. 395. n. 8 (May 1877).

Aru.

Nyctemeridæ.

94. *Nyctemera fasciata.*

Nyctemera fasciata, Walker, Cat. Lep. Het. vii. p. 1665 (1856).

Kandavu, Fiji.

95. *Nyctemera alternata.*

Nyctemera alternata, Walker, Cat. Lep. Het. Suppl. v. p. 1879 (1866).

Camiguen, Philippines.

96. *Pitasila inconstans.*

Pitasila inconstans, Butler, P. Z. S. 1880, p. 672. n. 47.

Camiguen, Philippines.

Catephiidæ.

97. *Cocytodes modesta.*

Catocala modesta, Van der Hoeven, Lép. Nouv. pl. vii. fig. 8.

Matuku, Fiji, July 24th, 1874.

Ophideridæ.

98. *Phyllodes cerasifera*, sp. n. (Fig. 3, p. 427.)

Allied to *P. consobrina* of Silhet, but larger; the primaries paler, more uniform; the secondaries with the anal patch considerably larger, more rounded, the central white patch upon it extending transversely upwards almost to the edge of the rose-red border. Expanse of wings 156 millim.

Pasananca valley, Mindanao.

Unfortunately only one damaged example was obtained. Allied species occur also* in Borneo and Java, that from the latter locality having been mistaken by Walker for the *P. inspicillator* of Guénée (an Amboina form, figured by Boisduval, and, in my opinion, not distinct from *P. conspicillator* of Cramer from the same locality). The species of *Phyllodes* can be arranged naturally in three groups as follows:—

1. *Species with an orange external border to the secondaries**.

a. Border of secondaries traversed by an irregular black line; primaries traversed longitudinally by a black line.

Phyllodes semilinea, Walker, Journ. Linn. Soc. vii. p. 176. Borneo.

b. Border of secondaries not traversed by a black line; primaries with two silvery white spots.

Phyllodes ornata, Moore, Descr. Lep. Atk. ii. p. 166 (1882). Darjiling.

c. Border of secondaries abbreviated, longitudinal line of primaries and silver spots wanting.

Phyllodes ustulata, Westwood, Cab. Or. Ent. 57, pl. 28. fig. 1. Darjiling.

2. *Species with an orange band across the secondaries.*

Phyllodes Eyndhovii, Vollenhoven, Tijd. voor Ent 1858, p. 86, pl. vi., = *P. fasciata*, Moore, P. Z. S. 1867, p. 69. Java and Darjiling.

3. *Species with a rose-red anal patch on the secondaries, usually more or less interrupted by a white patch.*

a. Species small, the red patch not touching the anal margin, darker towards anal margin, but not suffused with white.

Graphigona roseifer, Felder & Rogenhofer, Reise der Nov. Lep. v. pl. cxiv. fig. 7 (1875). Amazons.

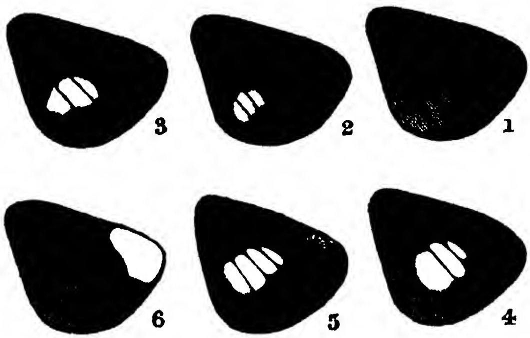
* *Phyllodes dux*, of Saalmuller, Stett. ent. Zeit. xlii. p. 441, from Nossi-Bé, if it be a true *Phyllodes*, will fall into this group; but a coloured figure forwarded to me by the author shows palpi with conical terminal article, indicating that it belongs to a distinct genus; the costa of primaries is also curved upwards at apex.

b. Species large, the red patch touching the anal margin, slightly suffused with white in some examples.

Phyllodes roseigera, Butler, P. Z. S. 1883. Andamans. (Fig. 1.)

c. The red patch more rounded, of a more crimson tint, with a conspicuous snow-white centre.

Phyllodes consobrina, Westwood, Cab. Or. Ent. 57, pl. xxviii. fig. 2 Silhet. (Fig. 2.)



Hind wings of *Phyllodes* (reduced).

d. The red patch considerably larger, the white patch within it also larger, extending nearly to the inner edge of its red zone.

Phyllodes cerasifera, Butler, suprà. Mindanao. (Fig. 3.)

e. The red patch crescent-shaped, only extending halfway round the white patch, which is rounded and very large; apex cinereous.

Phyllodes floralis, sp. n. Borneo. (Fig. 4.)

f. The red patch still more abbreviated, so as only to encircle one third of the white patch; the latter oblong.

Phyllodes Verhuellii, Vollenhoven, Tijd. voor Ent. 1858, p. 159. Java. (Fig. 5.)

g. The red patch dark, elongated, not suffused with or interrupted by white; the apex of secondaries broadly ash-grey or white.

♀. *Phyllodes conspicillator*, Cramer, Pap. Exot. ii. pl. xcvii. figs. A, B (1779) = ♂ *P. inspicillator*, Guénée. Amboina. (Fig. 6.)

In Cramer's figure the white patch appears to have travelled quite across the secondaries, from the centre of the red anal patch to the apex; moreover, as the white emerges from the red it seems to give off atoms in advance, so that the apical patch becomes gradually larger and whiter from its commencement in *P. floralis* (in which species the white is first seen to emerge from the red). Dr. Leuthner proposes the term "chromatropy" for this alteration in the position of colour-patches.

We see in this case how important it is to describe all the local forms which are known to be constant, since only by so doing can we hope to discover the laws which regulate the disposition of the colours and markings on the Lepidoptera.

Thermesiidæ.

99. *Azazia rubricans.*

Ophiusa rubricans, Boisduval, Faune Lép. Mad. p. 106, pl. xvi fig. 1.

Aru.

Hydrocampidæ.

100. *Hydrocampa*, sp.

Near *Zebronia? meritalis*; perhaps new, but too much injured for description.

Mindanao.

Botididæ.

101. *Astura fluminalis*, sp. n.

Primaries grey, semitransparent, the borders narrowly ochreous, and a large oblong spot of the same colour just beyond the cell; basal area tinged with ochreous; two irregular blackish stripes, as in most species of *Botys*, the outer one abruptly inangled from below the first median branch; a blackish spot near the end of the cell, and a submarginal series bounding the external border, the inner edge of which is irregularly zigzag; secondaries ochreous, with a small spot at the end of the cell, two irregular series towards outer margin, and a large subanal spot dusky: body ochreous. Under surface nearly as above, but the stripes across the primaries obsolete. Expanse of wings 27 millim.

Banks of the Wai Levu, Viti Levu.

One imperfect example, but so distinct from any species hitherto described, that I do not hesitate to characterize it.

LI.—*On the Embryology of* Hydra. By Dr. A. Korotneff *.

As to the evolution of *Hydra* we are still in much uncertainty, although its principal phenomena have already been indicated by the two earlier observers Kleinenberg † and

* Translated by W. S. Dallas, F.L.S., from the 'Zeitschrift für wissenschaftliche Zoologie,' Band xxxviii. pp. 314–321.

† N. Kleinenberg, 'Hydra, eine anatomisch-entwicklungsgeschichtliche Untersuchung,' Leipzig, 1872.

Kerschner *. The earliest investigations of Von Siebold and Max Schultze have no particular interest as regards the histogeny, for which reason I shall confine myself to the abovementioned memoirs of Kleinenberg and Kerschner, indicate the contradictions which occur in them, and then turn to my own observations in this department.

According to Kleinenberg the segmentation is perfectly equal, into 2, 4, 8, 16 parts, and so on, but no segmentation-cavity is formed. Neither the ovum nor the segments originating from it possess nuclei; the latter occur only in the future cells. The peripheral cell-layer becomes converted in course of time into a chitinous egg-capsule; and then a second membrane soon appears upon the egg within the capsule. Now, however, commences a period of relative rest, which is to be regarded as a true histolysis: the cells melt away; the nuclei disappear; and the germ becomes converted into a plasma-body which contains only yelk-nuclei (*pseudocells*, Kl.). In the interior of the protoplasm there is then produced a clear excentric space, which soon enlarges, and represents the first indication of the stomachal cavity. The external capsule soon splits, and the germ remains bounded only by the inner membrane. It is only now that is produced the first trace of the division of the wall into two layers, the ento- and ectoderm. The embryo then extends itself, and at one pole its wall becomes very thin; here a fissure makes its appearance; and the mouth is thus produced. Now, according to Kleinenberg, the clear outer layer divides up into separate cells; at the same time the tentacles make their appearance as hollow processes; and the embryo soon becomes free.

The description of the development of *Hydra viridis* by Kerschner differs essentially from that just given. After segmentation, according to Kerschner, a blastula is formed, whilst according to him there is no morula. Into the segmentation-cavity there is, from the pole directed towards the parent animal, an immigration of cells which form the entoderm. The ectoderm does not disappear during the formation of the chitinous envelope, but is retained. The entoderm, formed as above by immigration, acquires an appearance like that of connective substance, but changing from time to time by the development of protoplasmic cords and the spaces existing between these.

My own investigations relate chiefly to the development of *Hydra aurantiaca*, although I have also observed several stages of that of *Hydra fusca*. As signs of the maturity of

* Kerschner, Zool. Anzeig. no. 64 (Sept. 6, 1880), p 451.

the ovum we must regard two direction-vesicles, in which there are frequently one or two vitelline globules. These vesicles do not appear as derivatives of the division of one vesicle into two, but as independent formations at different points of the surface. At first the egg stretches itself out, but soon resumes its previous spherical form. Soon afterwards the germinal vesicle divides—a phenomenon which Kleinenberg has entirely overlooked, and I have myself only superficially observed it on account of the opacity of the egg. At the pole of the egg turned away from the body of the *Hydra* there appears a shallow depression, the margins of which form numerous pseudopodia. The further this furrow penetrates downwards the narrower it becomes, so as to form a fissure, which appears at the bottom as a narrow transverse canal. Finally the egg divides into two spheres, which are quite separate and only touch each other. Soon, however, the two spheres lay themselves closer together in the direction of their length, and then a division of the two nuclei takes place; after this a transverse fissure makes its appearance, which causes a separation of the egg into four spheres. The third divisional plane is equatorial; this produces eight spheres, which, however, soon contract in such a manner that the germ again becomes globular. The fourth and fifth divisional planes are so situated that they form two grooves running at equal distances from the equator; by this means we get a germ which consists of 16 cells. Now the first trace of an internal cavity is to be observed; it is produced because the inner extremities of the germ-cells are not in close contact, but have a small space free, which Kleinenberg overlooked but Kerschner has mentioned.

Hitherto the segmentation of the egg has taken place quite regularly; but now an irregularity is to be observed. This is most strongly marked in *Hydra fusca*, and especially in the cells which remain most intimately connected with the body of the parent *. While the cells which form the dome of the blastula become comparatively small by more rapid division, these large basal cells remain undivided, or, more properly, are retarded in their division; but then they become most active in the development of the embryo; they divide in a transverse and longitudinal direction, and form a second hypoblastic generation of cells, which occupy the primitive Baerian cavity. In this second cell-generation also large elements are to be observed, which must be regarded as a derivative of the basal

* Further on it will be shown how long this connexion with the parent organism persists.

cells of the blastula; these divide rapidly, and thus cause the complete filling-up of the previously existing cavity. In this way we arrive at a stage which is apparently analogous to a morula, but, as Kerschner correctly remarks, is not a true morula; for it is a secondary form which appears, not before, but after the formation of the Baerian cavity.

The upper cells of the germ, forming the dome, have no part to play in the production of the hypoblast, and persist without any alteration. The stage just described is a true transition form from a planula to a gastrula; the function of producing the hypoblast-cells is here assumed by the basal cells without their forming an invagination-sac. We have only to add that in the blastula the cell-nuclei are composed of strongly refractive granules, from which a number of radiating streaks run outwards. The second stage has already compact nuclei, in which staining distinguishes no nucleoli. The nucleus itself is enveloped by a quantity of quite clear and transparent plasma; but the chief mass of each segment consists of vitelline globules * of very different sizes.

After the internal cavity of the embryo is completely filled up, the previous egg-segments acquire the appearance of true cells; and these divide most rapidly in the outer epiblastic layer. We have now to mention a difference between *Hydra aurantiaca* and *Hydra fusca*. In the latter species we see the egg completely adherent to the parent-body, and it is not the egg but the free-swimming embryo that escapes from the parent *Hydra* after the bursting of the egg-capsule. In *Hydra aurantiaca* things take place as follows:—The ectodermal cells of the mother which are in contact with the egg gradually acquire a gland-like nature and take part in the formation of a pedestal or cup-like organ, which furnishes a sort of mucous substance, serving to effect the adhesion of the egg and to form a special layer around it. In *Hydra aurantiaca* a structure further occurs which effects the adhesion of the egg, not to the body of the parent, but to various plants or to the glass plates of the aquarium. This structure in *Hydra aurantiaca* proceeds from the embryo itself. The egg shows a separation of the epiblast and hypoblast. The greatest alteration is to be observed in the epiblast, the surface of which is no longer smooth, as before, but has acquired a tubercular appearance; at the same time a pseudopodium-like lobiform process is

* In my previous memoir (Nachr. für Liebh. der Natur, Bd. xxvii. Moscow, 1880) I have shown that these vitelline globules are to be regarded as metamorphosed nuclei of the cell-mass which serves for the formation of the egg.

formed by each of its cells. The outer border of the epiblast-cells with the processes acquires a yellowish shining border, the indication of a chitinous egg-shell. Each epiblast-cell then represents a cylindriform body, at the bottom of which various vitelline globules are to be observed; further outward is the nucleus; the above-mentioned process is clear and is formed of clear plasma, while the plasma of the cell itself is turbid and granular. At this time the egg separates from the body of the parent and adheres to various objects, a portion of the epiblast-cells undergoing a transformation. Of the cells which, as an uninterrupted layer, surround the embryo and possess processes, a portion acquires a turbid and coarsely granular appearance by a glandiform change which they undergo. At the same time also the form of these cells becomes altered; they become elongated, and so form a disk which gradually increases in size by multiplication of the cells, and at the same time spreads over a part of the surface of the germ. It is this disk by which the embryo attaches itself after separation from the body of the parent.

The glandular cells of the disk take part in the secretion of a sticky, mucous substance; when this is formed the cells become diminished in size, and no longer differ from the ordinary cells. The secretion of the sticky substance takes place gradually, and so that the substance appears to be composed of layers. It lies beneath the chitinous egg-shell and separates this from the cells.

In this stage the egg becomes perceptibly smaller, and a metamorphosis or histolysis of the hypoblast commences. The cells of the hypoblast lose their sharp demarcation from one another; their plasma, however, has become concentrated around the nuclei, and, as it were, ejected the vitelline globules; so that these are quite separated from the cells, and lie as it were outside of them in the intervals between them. The demarcation of the epiblast and hypoblast no longer appears so distinctly as before.

According to Kleinenberg the whole business of the formation of the egg-shell in *Hydra aurantiaca* takes place as follows:—Immediately beneath the free surface of the cells there is produced a space of lenticular form filled with fluid; its outer wall consists of an extremely delicate membrane, which is raised from the substance of the cell and seated upon it like a very convex watch-glass; its bottom is formed by a shallow impression of the body of the cell. The vacuoles soon lose their convexity; but the septa remain, and in this way form the plasma processes or spines with which the shell, as described by us, is surrounded. Kleinenberg has indis-

putably described the interspaces of the processes as vacuoles, and the spines or processes as the walls of the cells. According to his description the entire outer cell-layer of the germ becomes converted into a hard rigid structure, the egg-shell of the embryo; in *Hydra viridis* a complete conversion of the cells into a capsule occurs. According to Kerschner the ectoderm does not become converted into the chitinous envelope, but is persistent.

The further description will fully explain our own standpoint upon this subject. After the separation of the external spiny shell the embryo contracts, and soon secretes a second extremely thin membrane; according to Kleinenberg this membrane is produced by the hardening of a fluid which is secreted by the germ between its surface and the inner wall of the egg-shell*.

The epiblastic cells, after the secretion of the egg-capsule and vitelline membrane, are subjected to a retrogressive alteration: they soon acquire a coarsely granular texture; their nuclei become strongly refractive, drawn out in length, and curved. In proportion as the vitelline membrane thickens and becomes refractive the primitive epiblastic cells become smaller and smaller; they therefore undergo a degeneration until scarcely any trace of them is to be seen.

The nuclei of the hypoblastic cells at the same time divide; and this process is most strongly manifested at the periphery of the egg, at the bottom of the epiblastic cells. Soon these cells occupy the place of the primitive epiblastic cells, and form the secondary epiblast, or the definitive ectoderm of the *Hydra*. The succeeding stage has no longer the smallest trace of the primitive epiblastic cells. The demonstrated facts prove the following proposition:—*The primary epiblast is completely used up in the formation of the egg-capsule, the vitelline membrane, and the mucous layer, and takes no part in the development of the secondary epiblast.*

* Von Siebold ('Lehrbuch der vergleichenden Anatomie,' 1848, p. 51) describes the egg of *Hydra vulgaris* as enveloped by a delicate cobweb membrane, which issues from the cup-shaped organ. Before such an egg separates from its parent stock the envelope which immediately surrounds the vitellus acquires a firm consistence, and is at the same time coated by a gelatinous mass; then, in *Hydra vulgaris*, obtuse processes grow out from it all around, which lengthen, divide once or more at their apex, and thus acquire a pronged form. This description, according to Kleinenberg, is quite incorrect; but it seems to me possible to bring these facts into accordance with my own observations. The cobweb membrane is probably the extended cellular envelope belonging to the maternal organism which covers the mature egg before fertilization; the gelatinous mass is secreted in *Hydra fusca* from the glandular pedestal, and covers the egg, as has already been stated, even in the latest stages.

After the alteration of the peripheral cells of the hypoblast the same phenomenon is to be observed in the central cells. These begin to divide, and to migrate, as is so frequently the case in the eggs of insects, towards the periphery of the egg*. The division of the cells still goes on, and forms a layer of small cells of the interstitial tissue at the bottom of the ectoderm. Then the egg-capsule bursts, and the germ, still surrounded by the vitelline membrane, becomes free. A transverse section of this stage shows us the presence of the *membrana propria* and the development of the stomachal cavity. The cells of the entoderm are already completely developed and delimited. The stomachal cavity remains still for some time filled with a pasty mass, which contains vitelline globules.

In *Hydra fusca* the development of the egg-capsule takes place somewhat differently. We have already seen that here the mucous layer is formed by the parent animal itself. A perfectly smooth egg-capsule soon makes its appearance; and at the same time the epiblastic nuclei shrivel up. In a short time we see that the hypoblastic as well as the epiblastic cells form a common mass; the nuclei of the cells become pale, and afterwards disappear, without inducing a degeneration of the cell-body itself. At this time a vitelline membrane is secreted. After the setting-free of the primary hypoblastic cells a division takes place in these; and the newly formed cells migrate to the periphery and constitute the definitive epiblast. As regards *Hydra fusca*, therefore, it is established that *the cell-body of the epiblastic elements is not entirely exhausted with the secretion of the egg-capsule, but, after a conversion, also takes part in the plastic development of the germ.*

After the appearance of an internal cavity the embryo extends itself, becomes perceptibly elongated, and causes the vitelline membrane to burst. Soon afterwards the embryo acquires at one pole a mouth, which originates as a fissure at a thin-walled spot. Immediately after the formation of the mouth the tentacles make their appearance as hollow processes, as described by Mereschkowsky: at first there are two; and then the others are formed successively in pairs.

The great importance that Kleinenberg attaches to the disappearance of the outer epiblastic layer of the embryo is well known. When the epiblast is cast off, the nervous layer makes its appearance; and hence the ordinary ectoderm of *Hydra*

* The setting-free of the cells from the vitelline balls was observed by Tichomiroff in the development of *Bombyx mori*; I have also seen it in Bryozoa in the development of the statoblast.

would be a continuous layer of nerve-cells. This theory has already been discussed by several authors, and generally regarded as erroneous. My observations at the first glance seem to give some support to it. We actually find in *Hydra aurantiaca* the complete disappearance of the primary epiblast; in *Hydra fusca*, on the other hand, the cells which form the egg-capsules also take part in the formation of the definitive ectoderm. To be logical, therefore, we should have to assume that in one species the ectoderm is formed of nerve-cells, and that in another it consists of epithelium-cells. In my own opinion we may regard the metamorphosis of *Hydra* (its histolysis) as a direct result of external influences which are quite *sui generis* and furnish us with no grounds for any homologies. In the lower animals, the Cœlenterata especially, the principle of the formation of the organism out of definite embryological lamellæ cannot be carried through to its ultimate consequences; the function of the lamellæ is here not so specifical as in higher forms. An example of this is furnished by the formation of the nervous system. The ectoderm is certainly to be regarded as the starting-point of its formation; but in the Mollusca its origin from the mesoderm is almost everywhere demonstrated. Further, the investigations of the brothers Hertwig have shown that in the Cœlenterata (Actiniæ) the entoderm possesses quite independent nerve-elements, which may probably have an entodermal origin. Without venturing more deeply into this subject, I would affirm that in the development of the lower organisms we find exceptions to and modifications of the course of action which is to be regarded as the rule; and these probably are to be considered the results of adaptation. It is certainly indisputable that the adaptability is much more considerable in the lower organisms than in the higher; and for this reason external influences may completely transform the organism itself and its developmental history. It is only from this stand-point that the development of *Hydra* can be understood. I regard the pseudomorula of *Hydra* as a mass of embryonal cells which have no very definite part to perform in the plastic development of the organism. And if the outer layer of the morula becomes altered, and, instead of taking part in the development of the organism, forms a shell or skin for the embryo, this also is to be interpreted as a process of adaptation.

LII.—*Notes on Coleoptera, with Descriptions of new Genera and Species.*—Part V. By Francis P. Pascoe.

List of Genera and Species.

TENEBRIONIDÆ.

Bolitophaginæ.

Mychestes congestus.
Ozolais divisa.
—— gibbera.
Bradymerus violaceus.
—— cyaneipennis.

Ulominæ.

Toxicum gracile.
Anthracias ruficollis.

Cœlometopinæ.

Centronopus speciosus.

Helopinæ.

Phymæus (*n. g.*) pustulosus.

Cnodalinæ.

Thecacerus sycophanta.

Amarygminæ.

Amarygmus alienus.

Strongyliinæ.

Œnomia (*n. g.*) femorata.
Messalia (*n. g.*) varians.

Mychestes congestus.

M. oblongus, fusco-niger, supra confertim granulatus; prothorace utrinque leviter rotundato, in medio sulcato. Long. 5 lin.

Hab. Port Bowen.

Oblong, brownish black, above with numerous rounded close-set granules, all of nearly equal size; head convex in front; labrum narrow, rounded anteriorly; prothorax gibbous, rather longer than broad, moderately rounded at the sides, sulcate above; scutellum subtransverse; elytra narrower than the prothorax at the base, about twice as long as broad; prosternum grooved and slightly prolonged behind; body beneath and legs with a greyish-yellow squamosity covering small scattered hair-like scales.

In this species the antennæ are clearly 11-jointed, but the last joint is very closely applied to the tenth; in *M. lignarius* the two are apparently united so as to appear as one; in *M. Pascoei* there is a very faint line marking their limits. *M. Mastersii* I have not seen; but Mr. McLeay says the prothorax has a "projection" which "looks from above exactly like a head and neck." The crowded granules of nearly uniform size are distinctive of the above species.

Ozolais divisa.

O. fusca, squamositate grisea induta, supra sparse nitide granulata; prothorace quadrigibboso. Long. 4¼ lin.

Hab. Ega (Amazons).

Dark brown, covered with a greyish squamosity or crust, and above with small scattered glossy granules; head deeply concave in front, bounded above by a semicircular line of fine granules; antennæ pale ferruginous; prothorax very convex, the anterior and more elevated part impressed by two grooves, crossing in the middle, behind the middle the sides incurved, but expanding again at the base; scutellum rounded; elytra scarcely broader than the base of the prothorax, parallel at the sides, seriate-punctate, the alternate interstices tuberculate; body beneath and legs castaneous, with small scattered hair-like scales beneath the crust.

In this and other species of the Bolitophaginæ the thin crust is easily broken off; so that in most specimens fragments only remain.

Ozolais gibbera.

O. fusca, squamositate grisea induta, supra granulata; prothorace antice valde gibboso, in medio longitudinaliter anguste sulcato. Long. 4¾ lin.

Hab. Ega.

Dark brown, squamosity and granules as in the last; head deeply convex in front; antennæ brownish; prothorax gradually broader posteriorly, rising abruptly above the head into a large rounded hump, narrowly grooved longitudinally, and rather closely covered with equal-sized glossy granules; scutellum oblong; elytra rather broader than the prothorax, covered with numerous granules of varying size, and with an oblong compressed tubercle at the base of each.

A stouter species than the last, the prothorax different, &c. *O. scruposa* is a small species, and, *inter alia*, has a more transverse and less gibbous prothorax.

Bradymerus violaceus.

B. oblongus, violaceus, antennis, pedibus et corpore infra castaneis; prothorace angulis anticis acutis, sat fortiter et confertim punctato. Long. 4 lin.

Hab. Philippines.

Oblong, a clear violet colour above, the antennæ, legs, and body beneath chestnut-brown; head and prothorax closely punctured, the latter more coarsely, and having its anterior

angles acute; scutellum triangular, brownish; elytra slightly broader behind the middle, strongly striate-punctate, the interstices raised and smooth; body beneath and femora finely punctate.

The type of *Bradymerus* is a dark-coloured New-Caledonian insect described by M. Perroud in 1864 (Ann. Soc. Linn. Lyon, xi. p. 111).

Bradymerus cyaneipennis.

B. oblongus, cyaneus, capite prothoraceque cyaneo-nigris, subtiliter punctatis; antennis, pedibus et corpore infra rufo-castaneis. Long. 6 lin.

Hab. Ceylon.

Oblong, head and prothorax bluish black; elytra indigo-blue; antennæ, legs, and body beneath reddish chestnut; head and prothorax very minutely punctate, the latter with its anterior angles not produced; scutellum triangular, brownish; elytra parallel at the sides, strongly striate-punctate, the interstices raised and smooth; body beneath and legs finely punctate, the abdominal segments longitudinally striolate.

Toxicum gracile.

T. angustum, nigrum, nitidum; prothorace postice gradatim angustiore; elytris postice gradatim latioribus. Long. 4 lin.

Hab. New South Wales.

♂. Narrow, black, shining; head anteriorly with two short slender conical horns united at the base, posteriorly two others, much larger, curved, and approximating above, the upper half clothed anteriorly with long yellowish hairs; antennæ somewhat slender, the last four joints forming a moderately slender club; prothorax finely punctured, rather longer than broad, gradually narrowing posteriorly, the anterior angles rounded, a transverse fovea at the apex and three at the base; scutellum triangular; elytra seriate-foveate, slightly broader than the prothorax at the base, thence gradually broader towards the apex; body beneath and legs chestnut-brown.

The peculiar form is distinctive of this species. The female has two narrow ridges only, representing the posterior horns. The two species from Gayndah described by Mr. W. McLeay would appear, from their three-jointed antennal club, to belong to *Anthracias*.

Anthracias ruficollis.

A. oblongus, parallelus, obscure ater; prothorace transversim quadrato, saturate rufo. Long. $4\frac{1}{2}$ lin.

Hab. Matabello, Saylee.

♂. Unknown.

♀. Oblong, nearly parallel at the sides throughout, opaque, black; prothorax deep red; head with two ridges above the eyes; club of the antennæ dilated; prothorax transversely subquadrate, velvety, apparently impunctate; scutellum subcordate; elytra velvety, with scarcely visible punctures; body beneath and legs dark chestnut; tarsi ferruginous, all but the claw-joint very short.

I see nothing to distinguish this species generically from the European form. A specimen from Saylee has a darkish longitudinal stripe on the prothorax. Matabello is a small island south-west of New Guinea, where the species was found by Mr. Wallace.

Centronopus speciosus.

C. oblongus, supra nitidissime rufo-cupreus, infra pedibusque chalybeatus; antennis tarsisque piceis. Long. 6 lin.

Hab. Chontales.

Oblong, glabrous, very slightly convex; above a brilliant reddish copper; beneath, femora, and tibiæ steel-blue; antennæ and tarsi pitchy; head slightly punctate anteriorly; edges of the clypeus, which is scarcely distinct from the head, purplish; prothorax extremely finely punctate; scutellum transverse, steel-blue; elytra seriate-punctate, punctures minute oblong; fore tibiæ in the male with a small median tooth.

This species bears a marked resemblance to the Alpine *Feronia metallica.*

PHYMÆUS.

Caput subexsertum; *clypeus* apice emarginatus; *labrum* breve; *mentum* convexum. *Antennæ* modice elongatæ, articulo tertio quam quartus duplo longiore, ultimis quatuor clavam compressam formantibus. *Prothorax* transversus, subplanatus, utrinque rotundatus, apice late emarginatus, basi subtruncatus. *Scutellum* distinctum. *Elytra* convexa, breviter ovata; *epipleura* angusta. *Pedes* subelongati; *femora* et *tibiæ* lineares, muticæ; *tarsi* graciles, articulo ultimo elongato. *Mesosternum* perbreve; *prosternum* in mesosterno receptum.

I am unable to see the "very small" scutellum which Lacordaire attributes to *Osdara*, to which this genus is allied,

and from which it is otherwise differentiated by its emarginate clypeus, flattish prothorax, and very convex, or even gibbous, elytra with distinct epipleura.

Phymæus pustulosus.

P. niger, opacus; prothorace marginibus crenatis; elytris sat vage rufo-tuberculatis, tuberculis pedibusque nitidis. Long. 7 lin.

Hab. Ceylon.

Black, opaque, the labrum, tubercles, and legs glossy; head and prothorax minutely punctate, the latter somewhat expanded and crenate at the sides, the base with a linear elevated border; scutellum transversely triangular; elytra gradually rising from the base to the middle, and falling towards the apex, seriate-punctate, punctures very small and mixed with glossy reddish tubercles (about nine larger and three or four smaller on each elytron), the interstices towards the scutellum with a few minute black granules; femora and tibiæ glossy brownish black, the lower third of the latter and tarsi beneath thickly covered with light golden-brown hairs; body beneath shining black; the abdomen, except the last segment, closely punctured.

Thecacerus sycophanta.

T. ovalis, aureo-cupreus, scutello scutiformi; elytris minus punctatis, paulo ante medium tuberculis duobus elevatis instructis. Long. 7 lin.

Hab. Brazil (Minas Geraes).

Oval, coppery with a strong tinge of golden yellow; head finely but distinctly punctate; antennæ with the four penultimate joints about equal in length and breadth; prothorax very transverse, glabrous, a few minute scattered punctures and a shallow fovea on each side; scutellum scutiform; elytra irregularly punctate, the punctures varying in size, the shoulders conically produced, and each elytron having a large conical diverging tubercle, with the greater part of its base rather before the middle; beneath and legs very smooth and glossy.

A much narrower form than *T. nodosus*; in that species the four penultimate joints of the antennæ are transverse, the prothorax is not so short, the scutellum somewhat transverse and rounded behind, the elytra more coarsely punctate, and the two dorsal tubercles smaller and more remote from the base, and the colour is darker without any golden tint. The figure in Griffith's 'Animal Kingdom' represents this species better than *T. nodosus*, the type of which is in the British Museum.

Amarygmus alienus.

A. subellipticus, nitidissime cupreus, antennis, pedibus et corpore infra fusco-castaneis; prothorace scutelloque subtilissime punctatis. Long. 7 lin.

Hab. Ceylon.

Subelliptic, very glossy copper-coloured above; beneath, antennæ and legs chestnut-brown; head with a shallow fovea between the eyes, which are moderately approximate in front; clypeus marked off from the head by a deep semicircular line; prothorax broadly transverse, and with the triangular scutellum very minutely punctured; elytra rounded at the shoulders, moderately convex, each with eight lines of very small punctures; body beneath and legs glossy chestnut-brown; anterior femora gradually expanding into a very slight tooth in the middle.

A somewhat isolated species, compared with the numerous Australian forms; remarkable also for the small but distinct tooth on the anterior femora.

ŒNOMIA.

Caput breve; *clypeus* a capite sulcatim discretus. *Oculi* approximati. *Antennæ* breviusculæ, articulis a quarto dilatatis. *Prothorax* transversus, utrinque haud lineatus. *Elytra* oblonga. *Prosternum* postice rotundato-productum; *mesosternum* antice depressum. *Pedes* breves, intermedii et postici æquales.

There does not appear to be any genus of Strongyliinæ to which this can be approximated, although *Epiplecta* might be thought to be an exception, owing to the remarkable character of the antennæ. The widening of the joints begins with the fourth, which is equilaterally triangular; the remainder to the tenth are short, more especially dilated on one side, and rounded at the base; the last is smaller and rounded.

Œnomia femorata.

Œ. oblonga, nigra, parum nitida; elytris rufo-brunneis; femoribus, apice excepto, luteis. Long. 5 lin.

Hab. Para (Province of).

Black, with a very slight gloss, the elytra reddish brown; head closely punctured; antennæ dull black, about twice as long as the prothorax, third joint shorter than the fourth, gradually thicker towards the apex; prothorax rounded at the sides, minutely and closely punctate; scutellum triangular; elytra three times as long as the prothorax and a little broader at the base, the sides parallel, deeply striate-punctate, punctures oblong and approximate, interstices finely punctate; body

beneath glossy chestnut-brown; legs steel-blue, the femora, except at the apex, luteous yellow.

MESSALIA.

Caput breve, rotundatum; *clypeus* a capito lineatim discretus; *oculi* subapproximati. *Antennæ* longiusculæ, articulis a quinto dilatatis. *Prothorax* convexus, a pleuris linea elevata separatus. *Elytra* oblonga. *Prosternum* postice subacute productum; *mesosternum* antice depressum. *Pedes* elongati, intermedii longiores.

The antennæ are also dilated in this genus; but they are longer, and the dilatation begins at the fifth joint; the sixth and seventh are petiolated; the eleventh oblong, rounded at the apex; all these dilated joints are as long as they are broad. A raised line separates the flanks of the prothorax from its pronotum. The greater length of the intermediate legs marks a return to one of the characters of *Strongylium*.

Messalia varians.

M. oblonga, subcyanea, nitida; antennis nigris. Long. 5 lin.

Hab. Gilolo, Penang.

Oblong, light indigo-blue with purplish or violet reflections; head sparingly punctate, separated from the clypeus by a sharp well-marked line; antennæ black, about three times as long as the prothorax, third and fourth joints subcylindrical, the former longest; prothorax not quite as long as broad, the sides rounded anteriorly, parallel behind, sparsely punctate, the basal margin and scutellum inclining to azure; elytra about three times as long as the prothorax, much broader at the base, finely seriate-punctate; body beneath sparingly punctate; legs darker blue, inclining to violet.

LIII.—*Report on the Polyzoa of the Queen Charlotte Islands.* By the Rev. THOMAS HINCKS, B.A., F.R.S.

[Continued from vol. x. p. 471.]

[Plates XVII. & XVIII.]

Family Cribrilinidæ.

CRIBRILINA, Gray.

Cribrilina radiata, Moll.

Form *innominata*: off Cumshewa; Houston Stewart Channel.

[Form *with vibraculoid setæ*: Britain, chiefly south and south-west coasts; France (south-west), Mediterranean, Madeira, Gulf of Florida].

Some beautiful varieties of this variable species occur: the form which bears vibraculoid setæ is especially remarkable for richness of sculpture and delicacy of structure; it is furnished with a distinct (though minute) lunate pore, placed within the triangular space below the mouth. This character therefore is not distinctive as between the genera *Microporella* and *Cribrilina*, though it is always present in the former and very exceptionally in the latter. Smitt unites these genera in one family (Eschariporidæ *); but the very peculiar structure of the cell-wall in *Cribrilina* seems to entitle it to stand as the type of a separate group.

Family **Microporellidæ.**

MICROPORELLA, Hincks.

Microporella ciliata, Pallas.

Normal and forms *californica* (Busk), *vibraculifera* and *umbonata*, mihi.

[Normal: Arctic and northern seas; Britain, France (south-west), Mediterranean, Florida, Zanzibar, Australia, New Zealand, &c. Var. *californica*, California.]

Microporella ciliata, form *vibraculifera* †, n. (Pl. XVII. fig. 2.)

Avicularium replaced by a very tall membrano-chitinous vibraculoid process, situated on a rather large mound or swelling, the beak elevated at the sides and somewhat deeply notched or channelled at the extremity.

This is in many respects the most remarkable form which Dr. Dawson's dredgings have yielded. It occurs abundantly and in company with the normal *M. ciliata* and several interesting varieties.

I have already discussed (in the paper referred to) the curious morphological change which the avicularian organ has undergone in this variety, and its significance as illustrating the relation between the two appendages (avicularium and vibraculum). The mandible of the avicularium is frequently

* 'Floridan Bryozoa,' part i. p. 21.

† See a paper by the author "On certain remarkable Modifications of the Avicularium in a Species of Polyzoon; and on the Relation of the Vibraculum to the Avicularium" ('Annals' for January 1882, p. 20).

slightly elongated, and projects a little beyond the anterior extremity of the beak. In the present variety this elongation has been carried very much further, and at the same time a narrow chitinous expansion seems to have been developed along each edge of the setiform process thus formed. In this way a tall vibraculoid organ has taken the place of the normal mandible. The beak survives; but it too has undergone a certain amount of modification, tending to secure freer play for the movable seta. In general character the present variety agrees entirely with the ordinary forms of *M. ciliata.*

A glance at the three varieties represented on Pl. XVII. (figs. 1, 2, 3) will suffice to show what an amount of superficial difference there may be within the limits of one and the same species, and may well suggest those structural elements which should have most significance with the systematist, as indications of genetic affinity.

Microporella ciliata, form *umbonata*, n. (Pl. XVII. fig. 1.)

An umbonate process placed on each side of the orifice. Below the inferior margin a massive mamillary rising, which, when fully developed, conceals the pore. The entire surface thickly covered with rather large punctures, which are sometimes arranged in radiating lines.

Loc. Dolomite Narrows, on stone.

Microporella ciliata, form *californica.* (Pl. XVII. fig. 3.)

Lepralia californica, Busk, Quart. Journ. Micr. Sc. iv. (1856) p. 310, pl. xi. fig. 6.

This variety is abundant amongst the dredgings. The oœcium is sometimes very prettily adorned with ribs radiating from a central boss towards the base.

Microporella Malusii, Audouin.

Extremely abundant and very fine; one of the commonest species.

MONOPORELLA, Hincks.

Monoporella brunnea, n. sp. (Pl. XVIII. fig. 4.)

Zoœcia ovate or sometimes lozenge-shaped, quincuncial, moderately convex, separated by fine lines, sutures well defined; surface glistening, minutely granulated, punctured and reticulate, the punctures often more or less obliterated by the calcification; orifice arched above, lower margin straight or slightly curved inward, peristome not raised; the cell-wall

elevated below the mouth, so as to inclose a small cavity or chamber, within which is placed a slightly raised circular *avicularium*. *Oœcium* (?). *Zoarium* forming a light brownish crust.

In this species the surface glistens as if varnished. The cells are well defined and simple in structure. In the older zoœcia the punctures disappear beneath the calcification, the reticulations showing faintly through the stony crust.

Family **Myriozoidæ** (part.), Smitt.

SCHIZOPORELLA, Hincks.

Schizoporella auriculata, Hassall, form *ochracea*, Hincks.
(Plate XVIII. fig. 5.)

Off Cumshewa. [Britain, coast of Cornwall.]

I have not noticed the normal form of this species; but the variety which I have named *ochracea*, and which is characterized by the presence of an immersed oval avicularium on the front of the cell a short distance below the mouth, is not uncommon.

In the specimens from the Queen Charlotte Islands there is almost always a small nodule immediately below the avicularium, which is wanting in the British form.

Schizoporella Cecilii, Audouin.

Incrusting a *Cellepora*; a single specimen.

[Mediterranean, Australia, Britain (south-west), Channel Islands.]

Schizoporella hyalina, Linnæus.

Very abundant.

[Arctic seas, Britain, California, Africa, Australia, New Zealand, Falkland Islands, &c.]

Schizoporella sanguinea, Norman.

On shell, a single specimen of great beauty. Avicularia are altogether wanting.

[Britain (south-west), Mediterranean, Madeira, Florida.]

Schizoporella biaperta, Michelin.

Houston Stewart Channel; Virago Sound. On shell and stone.

[Britain (south), Arctic seas, Mediterranean, Madeira, Florida (deep water), Bass's Straits.]

The surface in the younger cells is thickly covered with minute punctures, which are more or less obliterated as calcification proceeds. A rounded avicularium is present on both sides of the orifice, and the large mamillated form with pointed mandible is also abundant.

Schizoporella sinuosa, Busk.

Shallow water, on shell.

[Scotland (west), and Shetland, Arctic seas, Gulf of St. Lawrence.]

Highly calcified, the oœcia being deeply immersed.

Schizoporella crassilabris, n. sp. (Pl. XVIII. fig. 1.)

Zoœcia large, elongate, ovate, quincuncial, very distinct, convex; surface dense, punctured (the punctures often obliterated by the calcification); orifice suberect, suborbicular, with a broad, rounded, shallow sinus occupying nearly the whole of the lower margin; peristome raised and thickened, forming a wall round the orifice, often massive in front, where it is carried out into a broad projection, notched or sinuated in the centre. *Avicularia* none. *Oœcium* large, rounded, broader than high, with rather large punctures.

Houston Stewart Channel, 15–20 fathoms, on small shells.

Schizoporella crassirostris, n. sp. (Pl. XVIII. fig. 3.)

Zoœcia ovate, quincuncially arranged, very convex, much elevated (gibbous) towards the oral region; surface dense, traversed by raised lines or ribs, radiating towards the sides; immediately below the orifice a tall and massive rostrum which occupies a large part of the front of the cell; on the inner side of it towards the base an avicularium placed transversely, mandible pointed, beak sharp and curved at the extremity; below the rostrum a smooth area, extending to the bottom of the cell, arched above, and marked off by a distinct line; orifice orbicular, with a shallow rounded sinus on the lower margin, occupying about two thirds of its width, peristome raised in the older cells; frequently a pointed *avicularium*, placed on the margin of the orifice and attached to one side of the rostrum. *Oœcium* (?).

On stone, a single specimen.

A very peculiar form, of which the striking feature is the large rostrum, which appears all the larger from the elevation of the cell-wall below the orifice. The defined area, with smooth surface below the rostrum, is no doubt the site of the oœcium, which was not developed in the specimen examined.

Schizoporella longirostrata, n. sp. (Pl. XVII. fig. 4.)

Zoœcia large, ovate, disposed in lines, moderately convex (sutures shallow); surface roughened or minutely granulated, covered with an epitheca; orifice arched above, lower margin extended into a wide, rounded, and shallow sinus, which occupies about three fourths of the width; peristome thin, sometimes elevated at each side; on one side of the cell, generally a little below the orifice, an elongate pointed *avicularium*, the mandible (which is broad at the base and tapering above) directed obliquely downwards, usually turned slightly outwards. *Oœcium* rounded, depressed in front, thickly punctured, with a shallow oral arch.

Off Cumshewa, on shell.

A curious diversity in the shape of the orifice occurs in this species. It is commonly as described in the diagnosis; but interspersed amongst the normal zoœcia are others in which the orifice is of a narrow elongate form, the sinus being deep and pointed, and less distinctly marked off from the rest of the oral opening than in the other case. The shape of the mouth in these cells is very regularly obovate. When covered with its epitheca this species is of a uniform light brown colour, and the granulose sculpture is almost concealed.

Schizoporella insculpta, n. sp. (Pl. XVII. fig. 5.)

Zoarium foliaceous and bilaminate, or incrusting. *Zoœcia* large, ovate, or narrow-oblong (often much elongated), quincuncial, depressed, separated by raised lines, sutures shallow; surface vitreous, glossy, thickly covered over its whole extent with punctures; orifice arched above, the lower margin almost entirely occupied by a wide, very shallow sinus; peristome thin, moderately raised, extended in front (beyond the sinus) so as to form a small chamber, in which is a rounded orifice (? avicularian). *Oœcia* profusely developed, very large (covering about two thirds of the cell above), elongate, rounded above, with a tall oral arch, thickly covered with slight granulated ridges, which radiate from the opening to the base, sometimes punctured round the base.

Virago Sound, attached to stems, from which it rises in free foliaceous expansions; Cumshewa Harbour. [Vancouver Is.]

The oœcium is sometimes extended at the top into a disk-bearing process, by which it is attached to the cell above (Pl. XVII. fig. 5 *a*).

Schizoporella tumulosa, n. sp. (Pl. XVIII. fig. 2.)

Zoœcia quincuncial, very regularly arranged, very convex,

ovate, much elevated centrally below the mouth, the wall sloping steeply down to the margin of the cell; surface dense, smooth, rather glossy, areolated round the edge, ridges radiating towards the centre; orifice orbicular, with a small central sinus, not contracted at the opening; peristome not elevated; immediately below the orifice, at one side of the sinus, a rostrum bearing on one side a pointed *avicularium*, the beak very slightly bent at the extremity, mandible directed upwards, the rostrum rising into a short mucronate point behind the avicularium; very commonly on the front of the cell, near the bottom, a much-raised *avicularium* (mounted on a prominent elevation) with a pointed mandible directed straight outwards. *Oœcium* rounded, smooth, much broader than high, with a tall oral arch filled in by a calcareous plate.

Off Cumshewa, in 20 fathoms, forming a brownish spreading crust.

Schizoporella pristina, n. sp. (Pl. XVII. fig. 6.)

Zoœcia ovate, irregularly disposed and shaped, moderately convex, separated by raised lines; surface thickly punctured, presenting (in older states) a reticulated appearance; orifice rounded above, the lower margin curving out below the opercular denticles into a wide rounded sinus, so that the mouth appears almost circular, peristome not raised, sometimes a thickened granulous border surrounding the orifice in front. *Avicularia* none. *Oœcium* (?).

Dolomite Narrows, on shell.

The oral sinus in this species takes its origin immediately below the denticles on which the opercular valve works, and is somewhat difficult to recognize. At first sight the orifice seems to be circular, as the sinus occupies nearly the whole of the inferior margin. The lower cell in the figure (Pl. XVII. fig. 6), which is represented with the operculum *in situ*, is defective in not showing the contraction below the denticles.

We have here, we may suppose, one of the primitive forms of the sinuated orifice, from which others may have been derived by contraction (more or less) or other modification of the marginal curve. The suboral pore of certain genera probably owes its origin to the isolation of the most specialized form of sinus, a central notch with contracted aperture.

Schizoporella maculosa, n. sp.

Zoœcia quincuncial, rather small, moderately convex, sutures shallow; surface shining, covered with small punctures, which are closed in by a brownish membrane, and give a

spotted appearance to the front wall; orifice arched above, with a shallow bluntly pointed sinus below, not contracted at the opening, peristome slightly thickened; on one side, just below the orifice (or occasionally on both sides), a small rounded *avicularium* on a prominent boss. *Oœcium* (?).

On shell.

The specimens of this form have unfortunately been mislaid; but I hope to be able to give a figure of it in a subsequent portion of the Report.

Schizoporella Dawsoni, n. sp.

Zoœcia ovate, or hexagonal, quincuncial, depressed or very moderately convex, separated by raised lines, highly calcified, vitreous; surface reticulato-punctate (punctures appearing as deep shafts in the vitreous crust); orifice arched above, much broader than high (narrow between the upper and inferior margins), a shallow rounded sinus in the centre of the lower margin, not contracted at the opening; peristome not raised, thickened round the sinus. *Avicularia* none. *Oœcium* rounded, closely united to the cell above, somewhat depressed in front, glossy, covered with rather large punctures; a prominent thickened border round the opening.

Virago Sound, on shell.

SCHIZOTHECA, Hincks.

*Schizotheca fissurella**, n. sp. (Pl. XVII. fig. 7.)

Zoœcia small, quincuncially disposed, ovate, the lower portion flattish, the oral region raised, tubular, suberect; sometimes punctured round the margin, sutures extremely shallow; surface smooth, porcellaneous, shining; orifice immersed, arched above, straight below, with a narrow slit-like sinus; (?) two spines on the upper margin; peristome thickened and elevated round the mouth, so as to form a kind of neck, carried out in front into a projection, which is notched in the centre and bimucronate; on each side a sharp spinous process, often wanting. *Oœcium* rounded, smooth, with a small longitudinal fissure above the opening, and a central tooth-like process just within the oral arch.

Dolomite Narrows; Cumshewa, &c.; not uncommon on shells and stone.

This is a very characteristic member of the genus *Schizotheca*, of which only two species have hitherto been recorded—

* Described as a *Schizoporella*, 'Annals' for September 1882, p. 253.

S. fissa, Busk (Britain and Mediterranean), and *S. divisa*, Norman (Britain). I have only noticed obscure traces of marginal spines, which constitute a very striking character in the British forms.

HIPPOTHOA, Lamouroux.

Hippothoa expansa, Dawson.

Common on shells; Houston Stewart Channel. [Shetland, Gulf of St. Lawrence, Davis Straits.]

Hippothoa distans, MacGillivray.

Cumshewa; Houston Stewart Channel. [Britain, Mediterranean, Singapore, Australia.]

MYRIOZOUM, Donati.

Myriozoum coarctatum, Sars.

Cumshewa; Houston Stewart Channel, 15–20 fms.; abundant and fine. [Vancouver Island, Campbell Island (British Columbia), Arctic seas, Norway.]

Family **Escharidæ** (part.), Smitt.

LEPRALIA (part.), Johnston.

Lepralia nitescens, n. sp. (Pl. XVIII. fig. 6.)

Zoœcia quincuncial, short-ovate, very ventricose; surface dense, vitreous, highly polished and glistening, smooth, with obscure radiating ridges, punctured, sometimes areolated round the margin; orifice much higher than broad, immersed in the older cells, arched above, slightly contracted a short way above the lower margin, which is a little curved outward; peristome not raised, the inner edge of the oral aperture finely denticulate, 3 or 4 spines above; on each side, in a line with the lower margin, a strong nodulous process; about the centre of the margin an *avicularium*, with rounded mandible, placed on a swelling, which extends some way down the cell, and facing sideways, mandible directed upwards; often on the front of the cell near the bottom (towards one side) a bracket-like projection, bearing a rounded *avicularium*. *Oœcium* (?).

Zoarium forming a brownish patch on shells.

Houston Stewart Channel; Cumshewa; Virago Sound (probably).

EXPLANATION OF THE PLATES.

Plate XVII.

Fig. 1. *Microporella ciliata*, Pallas, form *umbonata*, Hincks.
Fig. 2. *Microporella ciliata*, Pallas, form *vibraculifera*, Hincks.
Fig. 3. *Microporella ciliata*, Pallas, form *californica*, Busk.
Fig. 4. *Schizoporella longirostrata*, n. sp.
Fig. 5. *Schizoporella insculpta*, n. sp. 5 *a*. Oœcium.
Fig. 6. *Schizoporella pristina*, n. sp.
Fig. 7. *Schizotheca fissurella*, n. sp. 7 *a*. A zoœcium showing the primary orifice.

Plate XVIII.

Fig. 1. *Schizoporella crassilabris*, n. sp.
Fig. 2. *Schizoporella tumulosa*, n. sp. 2 *a*. Oœcium. 2 *b*. Orifice of marginal cell.
Fig. 3. *Schizoporella crassirostris*, n. sp.
Fig. 4. *Monoporella brunnea*, n. sp. 4 *a*. Zoœcium showing the suboral avicularium.
Fig. 5. *Schizoporella auriculata*, Hassall, form *ochracea*.
Fig. 6. *Lepralia nitescens*, n. sp. 6 *a*. A young zoœcium.
[A figure of *Schizoporella Dawsoni* will be given hereafter.]

BIBLIOGRAPHICAL NOTICES.

Cassell's Natural History. Edited by P. Martin Duncan, M.B. (Lond.), F.R.S., &c. 6 vols., large 8vo. London: Cassell, Petter, Galpin & Co., 1877–82.

The enterprising publishers of the book of which the above is the title have brought out a considerable amount of popular scientific literature, some of it good, some indifferent, or even worse. A former natural history of animals, we think in four volumes, fell under the second of these categories; and the publishers, in commencing the issue of a new work with the same scope, have certainly acted wisely in entrusting its superintendence to the hands of a naturalist of repute like Prof. Duncan. The advantage of such a course is pretty clear in the quality of the work produced, which, although somewhat uneven, owing to the varying idiosyncracies of numerous authors and to another cause to which we shall have to advert, is certainly much higher than we are accustomed to meet with in books of the same description.

In connexion with the first of the above-mentioned causes of difference in the treatment of different departments of the subject, it must be remarked that it would be impossible for any amount of editorial supervision entirely to prevent such divergence, complete uniformity of treatment being attainable only in the case of the

work of one hand, and then probably at the sacrifice of other qualities which are obtained by entrusting the preparation of the various parts to specialists.

With regard to the second source of inequality there is more to be said. In the old idea of a natural history, such as might be founded upon the writings of Buffon and Goldsmith, the beasts, birds, and fishes occupied the most prominent places, and got by far the greater part of the space at the author's disposal, a proceeding that we can easily understand, seeing that the Vertebrates, and especially the higher forms of them, had already received much attention from naturalists and travellers, while very little was known of either the structure or the habits of the members of the Invertebrate classes.

We have before us a popular natural history published in 1831. It bears the title of 'Buffon's Natural History of the Globe and of Man; Beasts, Birds, Fishes, Reptiles, and Insects,' is in four octavo volumes, had as its author or editor John Wright, M.Z.S., and may be regarded as having held the place, fifty years ago, of the popular natural history just published by Messrs. Cassell. Of the four volumes three are occupied with a general account of the structure of the earth &c. and with the natural history of Man, quadrupeds, birds, and fishes, the last-named class including the whales, dolphins, &c.; while the fourth volume includes the account of the invertebrate animals and of the reptiles, which the worthy M.Z.S. seems to have regarded from a very peculiar point of view. Thus the third volume having concluded with fishes, the fourth begins with shell-fish, among which we find the turtles and tortoises intercalated between the Crustacea and the Mollusca! the succeeding chapter deals with reptiles, as to the true nature of which our author seems to be pretty much in the dark, as will be seen from the following general remarks on lizards, which it is desirable to rescue from oblivion if only as a sample of the zoological pabulum offered to the public only half a century ago. "It is no easy matter," says the author, "to tell to what class in nature lizards are chiefly allied. They are unjustly raised to the rank of beasts, as they bring forth eggs, dispense with breathing, and are not covered with hair. They cannot be placed among fishes, as the majority of them live upon the land; they are excluded from the serpent tribe by their feet, upon which they run with some celerity; and from the insects by their size; for though the newt may be looked upon in this contemptible light, a crocodile would be a terrible insect indeed."

The serpents follow the lizards and newts, and apparently were not regarded as reptiles by Mr. Wright; and then come the insects, as to which group the author's notions seem to be exceedingly vague, for while his definition of Insects would apply only to the air-breathing Arthropods, he includes in the group the whole of the Invertebrata except the Mollusca, and even some of them. His order of wingless insects contains spiders, scorpions, centipedes, fleas, lice, bugs, the woodlouse, the water-flea, and the leech! The winged insects form three orders; and all the rest, worms, starfish, cuttlefish, the polypus, corals, sponges, &c., go together under a fifth

order, "a numerous tribe lately discovered, to which naturalists have given the name of zoophytes." The characteristic of this remarkable group is that its members "may be propagated by dissection." The "polypus" is called an insect and a reptile within a single page; and of course the coral-polyps are insects. It seems hardly credible that not much more than fifty years ago such crude notions could have been gravely put forward in a respectably got-up book, many of the illustrations in which are borrowed from the beautiful works of the late E. T. Bennett descriptive of the Tower Menagerie and of that of the Zoological Society.

Of course we have nothing to do with criticising a book which may be regarded as completely defunct, and we have simply taken it as exemplifying the sort of information that was considered suitable for the general public at the date of its production. Dr. Duncan and his coadjutors in 'Cassell's Natural History' make no attempts at such original flights as we have above indicated; but, singularly enough, in the matter of the space assigned to the great divisions, we find a remarkable accordance between the older and the newer work. Thus, in the new Natural History, the Vertebrates occupy just about three quarters of the whole book, the Mammals have two volumes and a half (out of six) allotted to them, and of these the Quadrumana alone occupy more than two thirds of a volume, a proportion which, notwithstanding the interest attaching to those cousins of ours, we cannot but regard as excessive. The Birds have about a volume devoted to them; and the Reptiles, Batrachia, and Fishes make another volume, leaving about one volume and a half for the whole of the Invertebrates. The fact is, the work opened as if it had been intended to extend to twenty or thirty volumes; and as it was limited to six, the later groups are starved. This result is much to be regretted, as it, to a certain extent, spoils what would otherwise have been an excellent book; and we would suggest to the publishers that at some future date, in a reissue of the work, they should add to it one, or even two, more volumes, and get the whole of the history of the Invertebrata reconstructed. If this were done it would make the best popular treatise on zoology that we possess.

Curiously enough, sitting down with every intention of writing a laudatory notice of this book, we have been betrayed into a long statement of shortcomings. This, however, is not difficult of explanation; the inequality to which we have felt compelled to call attention is *the* defect of the book, which in other respects is deserving of high praise. The authors, one and all, seem to have done their work with a conscientious desire to produce a satisfactory result; and, notwithstanding some little defects here and there, it must be confessed that they have been remarkably successful. Throughout the Vertebrata, but especially among the Mammalia and Birds, which, as we have stated, are treated at greatest length, the natural history of the animals is described with a detail which we are not accustomed to, and the scientific information given in connexion with the structural characters of the groups and the general principles of

classification is generally, both in quality and amount, admirably adapted to the requirements of the readers for whom the book is particularly intended; while even the student will find much that is useful to him. At the same time it must be borne in mind that the book was never intended to serve as a student's text-book.

The portion of the work devoted to the Invertebrata, from its much greater condensation, differs considerably in character from the rest, and approaches nearer to what we are accustomed to see in smaller zoological manuals. Still the same careful treatment is recognizable throughout, and the various authors have made the most of the space at their disposal.

Considering the number of writers engaged in the preparation of the book, Dr. Duncan is to be heartily congratulated upon having secured so general a harmony among them with regard to points on which a difference of opinion might exist; so far as we can see, there is no serious divergence between any two of the numerous independent articles.

How great were the chances of divergence will be easily seen from the following statement of the authors and the work done by them. The editor himself has written the articles on the Apes and Monkeys, the Edentata and Marsupials, the Reptiles and Amphibia, the Vermes, Zoophytes, and Infusoria, besides taking part with Dr. Murie in the preparation of that on the Lemurs, and writing a short introductory note on the general characters and classification of the Invertebrate animals. Besides the Lemurs, Dr. Murie contributes the articles on the Seals, Cetaceans, and Sirenia. Mr. W. S. Dallas has had assigned to him the Bats, Insectivora, and Rodentia among the Mammals, the whole of the articles on Insects except the Coleoptera and Lepidoptera, and those on Myriopoda and Arachnida. Profs. W. K. and T. J. Parker have undertaken the Carnivorous Mammalia; while what used to be called the Ungulata are worked up by Prof. W. Boyd Dawkins, Mr. H. W. Oakley, and the late Prof. A. H. Garrod. The Birds were consigned to Mr. Bowdler Sharpe of the British Museum, and the Fishes to Prof. H. G. Seeley. Several important groups of Invertebrata have already been noticed; the others are disposed of as follows:—The Crustacea and Mollusca are taken charge of by Dr. Henry Woodward, and the Brachiopoda and Bryozoa, placed under the head of Molluscoida, by Miss Agnes Crane; the Coleoptera and Lepidoptera are treated by Mr. Bates and Mr. Kirby respectively, the Echinodermata by Mr. P. Herbert Carpenter, the Sponges by Prof. Sollas, and the Rhizopods by Prof. T. Rupert Jones. While such a list of contributors as the above promises well for the quality of the articles written by them, it must be confessed that, at the same time, it offers abundant openings for differences of opinion.

We have still a few words to say about the illustrations of the book, which are exceedingly numerous and, for the post part, very good. A considerable proportion of them, indeed, have already appeared in French and German works; but a great number have been prepared expressly for the present book, and the sele tion

made is generally judicious. From the literary, the scientific, and the artistic point of view, 'Cassell's Natural History' must be characterized as a success.

Die Ammoniten des schwäbischen Jura. By F. A. Quenstedt. Erstes Heft. Pp. 48. 8vo, with 6 plates folio. Stuttgart, 1883.

According to the author's own account, he has been incited to the publication of this work by the appearance of Dr. Wright's Monograph of Lias Ammonites in the volumes of the Palæontographical Society, and his desire to show that the Ammonite-zones hold good in his own corner of Germany as elsewhere. We have here, however, only the first instalment out of ten or twelve which are to appear, according to the advertisement, in about four or five years. As the present contains only part of the Ammonites of the Lower Lias, it seems very unlikely that even twelve parts could possibly represent on the same scale any thing like the known Ammonites of the whole Jura. If the whole work were finished as it is begun it would be a splendid Monograph; for the figures are magnificent. They are too crowded, as in all Quenstedt's plates; but individually they leave nothing to be desired. Systems of nomenclature may change; but a faithful figure is always of value: and this remark is specially applicable in the present case; for the names applied could not possibly be used. There are some who favour a trinomial nomenclature; but we see in this work what it gradually leads to—"Ammonites psilonotus lævis ovalis" is not the only multinomial designation employed. The modern nomenclature is treated in rather a cavalier manner. Speaking of the first species he says that Hyatt named it *Psiloceras*, and Waagen *Ægoceras*, but he would rather call it *Psilonoticeras*, as then it would be known we were speaking of a Psilonote Ammonite. Yet this name is not actually adopted. It is plain that Quenstedt does not believe in the ordinary specific nomenclature; so that those who do will obtain little assistance from him; but with such plates as these they can apply their own names and be thankful for the many valuable descriptive notes given in the text. It is too soon as yet to judge of the whole work; and when we remember that it is now just forty years since its author first appeared before a former generation of geologists, we cannot help expressing the hope that he may have health and strength to complete it. Its value will then be more easily appreciated, and a further notice will be given. J. F. B.

MISCELLANEOUS.

Oxycorynia, *a new Synascidian Genus.* By Dr. R. von Drasche.

The author describes a remarkable form of compound Ascidian received by the zoological cabinet at Vienna from the Museum Godeffroy, and obtained from Hogoleu, one of the Rouk Islands in

the Caroline archipelago. The animals are arranged in heads presenting a general resemblance to a fir-cone, and supported upon cylindrical stalks, which, in the specimen described, are about 2½ inches long and rather more than ¼ inch thick. The oval spikes, which are sometimes pointed at the apex, attain a length of about 1¼ inch and a breadth of ⅝ inch. The colour of the badly preserved specimen is a dingy yellowish green. The branchial aperture is surrounded by a stellate marking; and on each side of the endostyle two or three parallel dark lines run down from the branchial aperture; dark pigment also appears round the cloacal aperture.

The individual animals are 10 millim. (⅜ inch) long, of which about 6 millim. belong to the branchial sac. The latter is of an elongated form, narrowed before and behind; and its hinder part covers a good deal of the intestine. At the foremost part of the animal is the simple round cloacal orifice. The branchial aperture is placed in the anterior third of the branchial sac; it is comparatively large, and surrounded by a very delicate cylindrical membrane, often cleft into four parts. Examined from within, the branchial aperture is seen to be surrounded by a frill-like ring, which appears strongly coloured by pigment-granules. Outside this there are eight tentacles, alternately large and small. The short œsophagus leads into a small smooth stomach, the intestine proceeding from which forms a loop to the left of the œsophagus, and bends forwards, passing into the rectum, which is filled with fæcal masses, and may be traced nearly to the cloacal aperture. Within the loop of the intestine are placed the ovaries and the racemose testes, which consist of about six follicles, each of which opens by a small duct into the common *vas deferens*, which is traceable along the rectum. Posteriorly each individual animal has a filiform appendage, which passes into the common peduncle, in which it may be traced to a long distance by transverse sections. This appendage is divided by a septum into two parts. The peduncle itself consists of a dense tunic-mass, in which the well-known large vesicular cells with parietal nuclei are present in great quantity. The individual animals are united by an extremely delicate colourless tunic. The individuals seated upon the margin of the peduncle are short-stalked; and their stalks gradually increase in length towards the middle, thus producing the spike-like form of the colony.

The caudate larvæ lie partly in the branchial cavity itself, partly in diverticula of the body-wall. The embryo is characterized by a peculiarly formed appendage which bears five adhesive glands. All the embryos observed showed indications of branchial hoops.

At the summit of the common peduncle, where the appendages of the individual animals enter it, there are numerous much-branched diverticula of these ectodermal processes. These bud-foundations form a conical elevation in the middle of the head; and the development of the buds seems to take place as described by Kowalevsky in *Didemnum styliferum* and *Amouroucium*.

The new genus approaches nearest to *Chondrostachys* of J. D. Macdonald (Ann. & Mag. Nat. Hist. ser. 3, vol. i. p. 401, pl. xi.), from Bass's Straits. In the position of the two apertures, the four-lobed character of the ingestive aperture, and the structure of the intestine this agrees precisely with the new species from the Rouk Islands. In *Chondrostachys* also the ovaries and testes are placed in the loop of the intestine, and the tailed larvæ lie partly in the branchial space, and partly in diverticula of the walls; but in *Chondrostachys* the individual animals are *not* united by a tunic, but arranged separately on the common peduncle, and the tunic of the individuals is of considerable thickness. The new form is named *Oxycorynia fascicularis*.—*Verhandl. zool.-bot. Gesellsch. in Wien,* Bd. xxxii. (1882), pp. 175–177, pl. xi.

On the Direct Reproduction of Tapeworms. By M. P. Mégnin.

On making a post-mortem examination of a little pet dog which died at the age of four months under epileptiform attacks which had troubled it for a month, I found in its intestines three large tapeworms of the species *Tænia serrata*, Goeze, from 0·50 to 0·80 metre in length, which were at least two months old, and a dozen young tapeworms from 0·003 to 0·010 and 0·015 metre in length. It is certain that the large *Tæniæ* were contracted at the kennel where the young dog was bred, either by more or less direct contact with other dogs, or by food or drink containing germs of *Tæniæ*. As to the young tapeworms of a few millimetres length, which consequently had only been a few days in existence (a *Tænia* of eighteen days being several inches long according to Van Beneden's experiments), it is impossible to explain their presence otherwise than by a direct reproduction by means of ova furnished by the large tapeworms and hatched in the intestines; for during the last month of the life of the young subject, when I had it constantly under my eyes, I am absolutely certain that its nourishment was of perfect purity, and that it did not swallow either *Cysticercus* or *Cœnurus*, which are still regarded, erroneously, as the sole germs that can furnish tapeworms. This is therefore an example of direct reproduction of tapeworms without the intervention of any larval migration.

A proof that even in man the proglottides of tapeworms, detached from the strobila, may remain for a long time in the intestine, evacuate their ova there, and even acquire extraordinary dimensions, is furnished by some proglottides which I possess, and which were passed by a young man. These proglottides are 0·035 metre long and 0·005 metre wide, and no longer show more than a few ova scattered through their tissue. It is by the hatching of the ova thus deposited and the penetration of the embryos into the tissues that we can explain the development of the measly state in man and in the dog; and the examples of the persistence during several years of an infection of tapeworms furnished by the human subject are probably cases of the direct reproduction of *Tæniæ* in the intestine.—*Comptes Rendus*, May 7, 1883, p. 1378.

Note on the Carotids of Rhea americana. By Franklen P. Evans, Esq., University College, Bristol.

In dissecting a young but almost full-grown specimen of *Rhea americana* I find that the right carotid is evidently present, though it is much smaller (about $\frac{1}{10}$ inch diam.) than the left. Its position for some distance past its origin corresponds to that of the left carotid; but subsequently, instead of converging to meet the latter, which runs along the hypapophysial canal, it continues onwards by the side of the right pneumogastric nerve and jugular vein. As the late Mr. A. H. Garrod, in his paper on the carotid arteries of birds (P. Z. S. 1873, p. 470), states that normally the left carotid alone is present in this species, it is possible that this difference is due to age; if so, it is interesting to find that a structure, the absence of which in the adult bird is regarded by Mr. Garrod as of sub-family importance, is originally present in the young bird, persisting even until close upon sexual maturity. Perhaps this may explain the conflicting statements of Prof. Owen with regard to the anatomy of *Apteryx* as quoted by Mr. Garrod.

On the Origin of Alternation of Generations in Hydro-Medusæ. By W. K. Brooks.

It is hardly possible that the form of development which we now find in most of the hydro-medusæ can bear any close resemblance to their primitive life-history; and there are many reasons for believing that alternation of generations has gradually arisen through the modification of "metamorphosis."

In *Cunina* we seem to have the ancestral form of development, a direct metamorphosis without alternation. The interesting and remarkable life-history of *Cunina* was first described by Prof. John McCrady, who found inside the bell of a hydro-medusa, *Turritopsis*, at Charleston, S. C., a number of hydra-like larvæ attached by short tentacles to the subumbrella, and furnished with a very long and flexible proboscis, with the oral opening at its tip. These larvæ are parasitic; and they obtain their food by inserting the proboscis into the mouth of the *Turritopsis*, and thus sucking from its stomach the food which it contains. In his first paper upon the subject Prof. McCrady stated his belief that these larvæ were the young of the *Turritopsis*, which carries its young inside its umbrella and nourishes them with partially digested food from its own stomach. Although McCrady soon corrected this error, and showed that they are not the young of *Turritopsis*, but the larvæ of *Cunina*, Romanes, in his recent work on 'Animal Intelligence,' has quoted McCrady's error without his correction, and refers to this instance of parasitism as a case of maternal care for the young among the Cœlenterata.

During the past summer both *Turritopsis* and *Cunina* were extremely abundant at Beaufort, N. C., throughout July and August, and I was fortunately able to trace the life history of each of them.

The larva of *Cunina* is a hydra, with the power of asexual multiplication; but instead of giving rise to medusa-buds like an ordinary hydroid, it becomes directly converted into a medusa by a process of metamorphosis; it is a true larva and not an asexual generation, although the occurrence of asexual reproduction renders the gap between this form of development and true alternation very slight indeed.

In *Cunina* we have a series of this kind:—

Egg,
|
Larva — Larva — Larva,
| | |
Adult Adult Adult.

If the larva which is produced from the egg were to remain permanently in the hydra stage, we should have a series like this:—

Egg,
|
Hydra — Hydra — Hydra,
| |
Medusa Medusa;

and such a history would be a true alternation.—*Johns Hopkins University Circulars*, April 1883, p. 73.

Ophryocystis Bütschlii. By M. A. Schneider.

I have discovered in the Malpighian vessels of *Blaps* a most curious new sporozoarium. It has the form and external appearance of an *Amœba*; its body is often covered with simple or divided digitiform processes, which may equal or exceed the central mass in length. The latter, which is charged with granules, contains from one to ten spherical nuclei 3 μ in diameter, with one or two punctiform nucleoli.

The multiplication of the species is effected principally by cysts. Encystment takes place only between individuals with a single nucleus and of spherical form. The two conjugated organisms secrete around them successively several envelopes, each marked with an equatorial line of dehiscence.

The phenomena which succeed one another in the cyst are very peculiar. Each of the two nuclei divides so as to produce three nuclei in the corresponding half of the cyst. Of the six nuclei thus produced, only two take part in the constitution of the reproductive elements, represented exceptionally by two small spores, and normally by a single large spore. A portion of the plasma of the cyst is implicated with the nuclei in this spore-formation. The four other nuclei and the rest of the granular mass of the cyst remain unused and become liquefied. The spore, resembling a Navicula, produces in its interior, besides a residuary nucleus, a certain number of falciform corpuscles, each provided with a nucleus.—*Comptes Rendus*, May 7, 1883, p. 1378.

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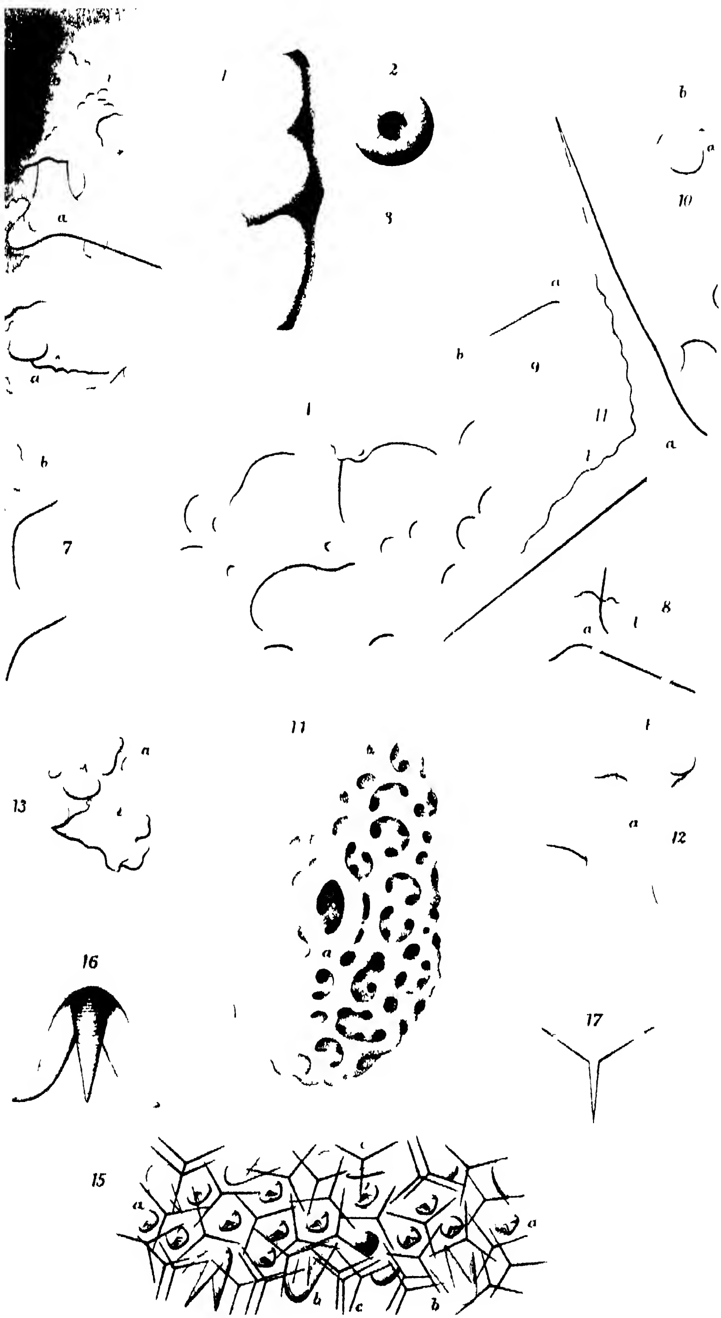

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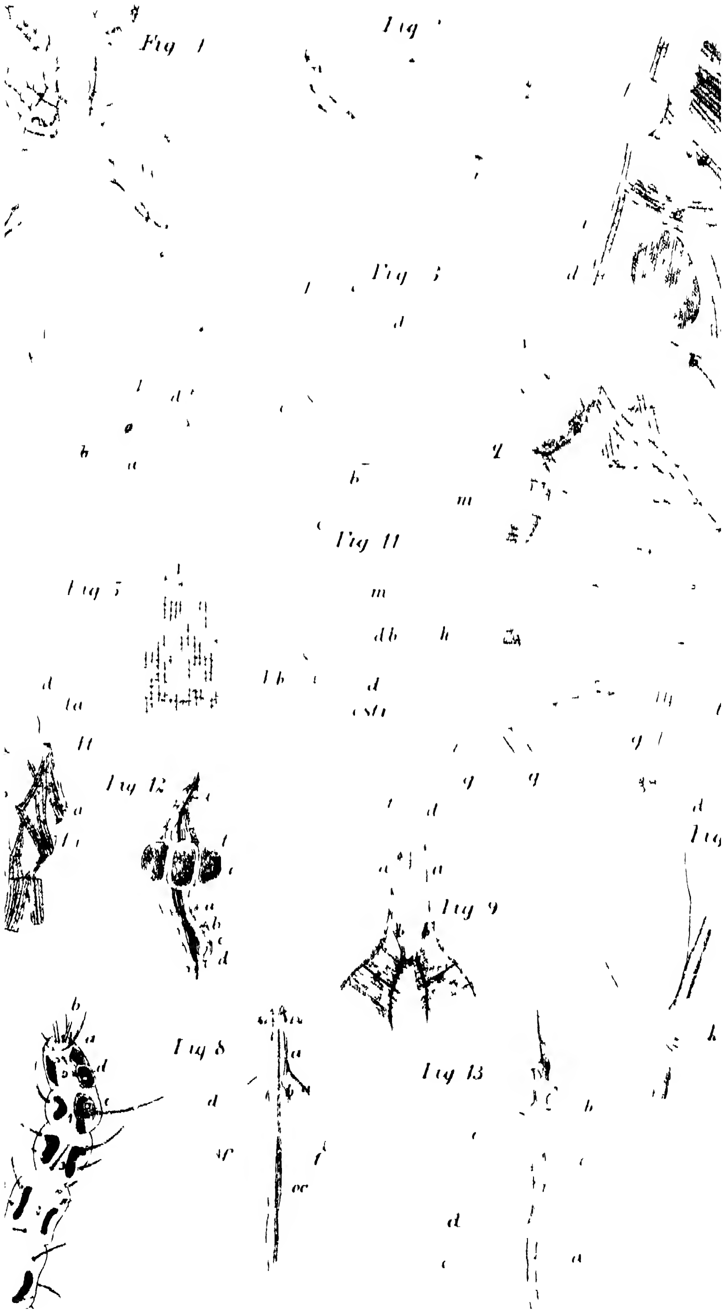
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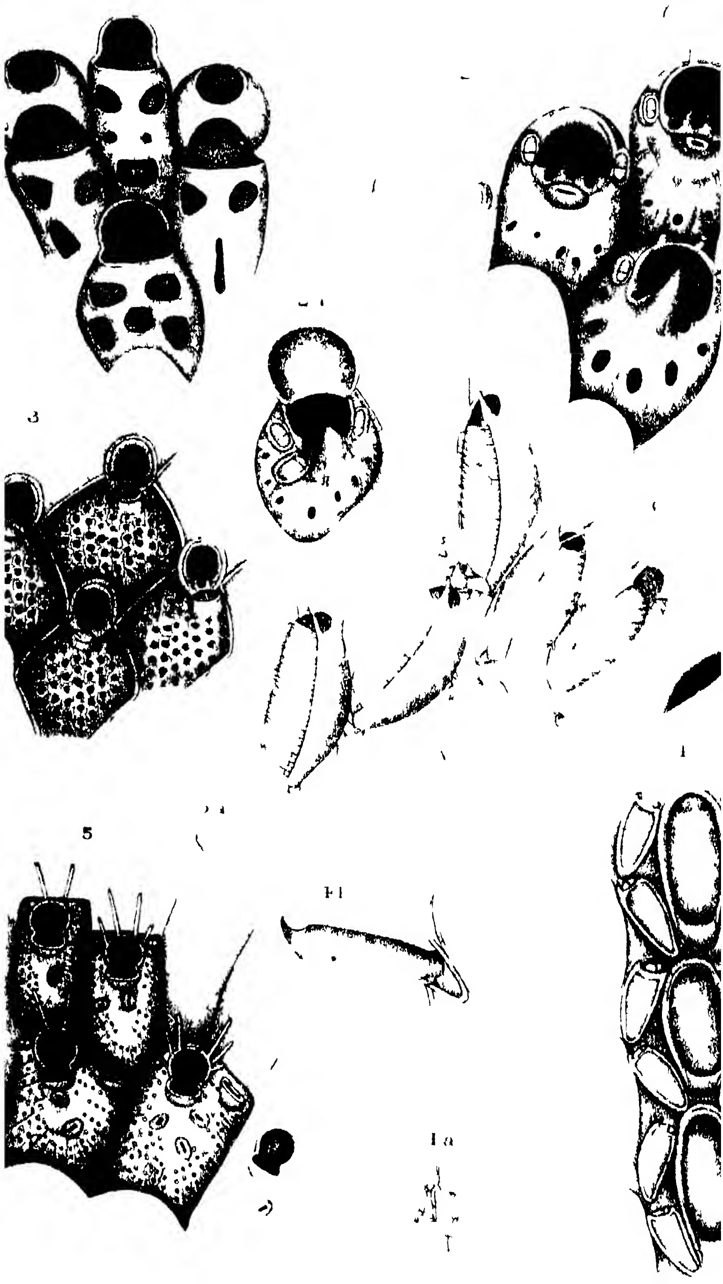
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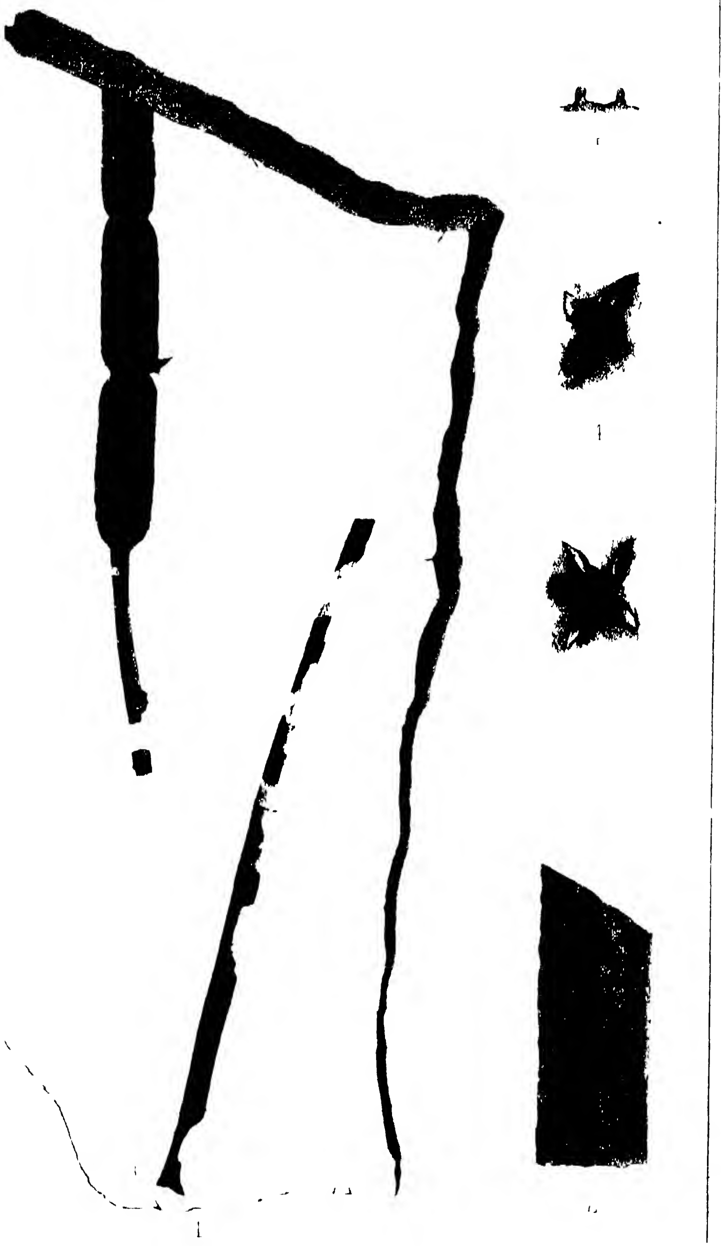

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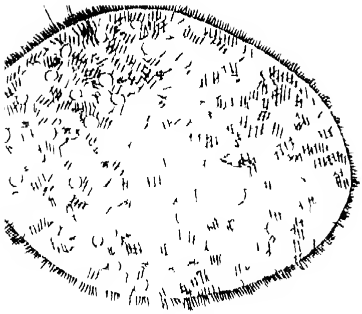

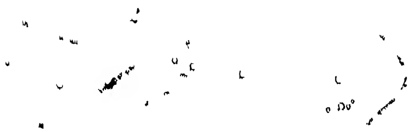

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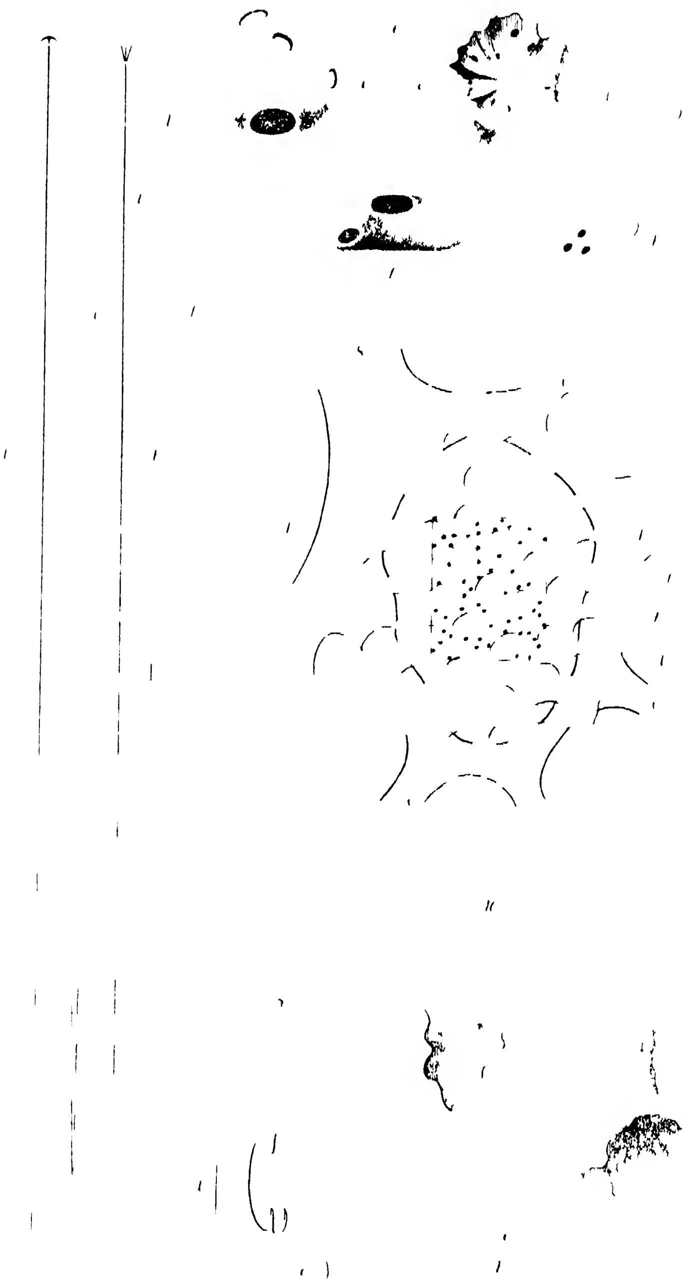

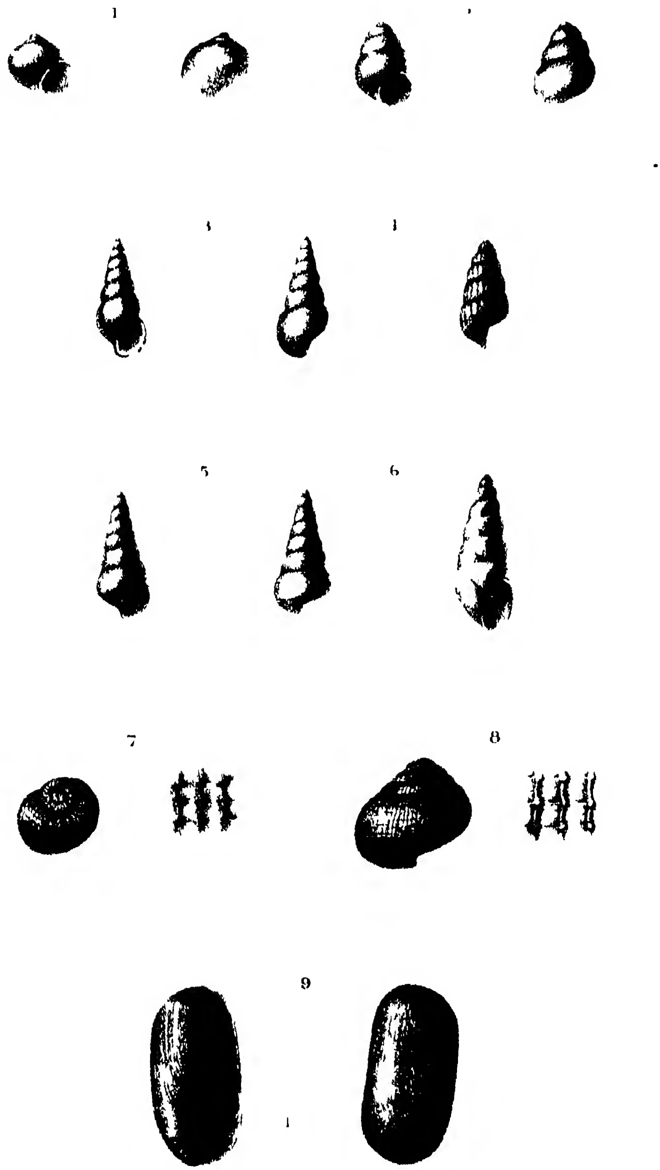
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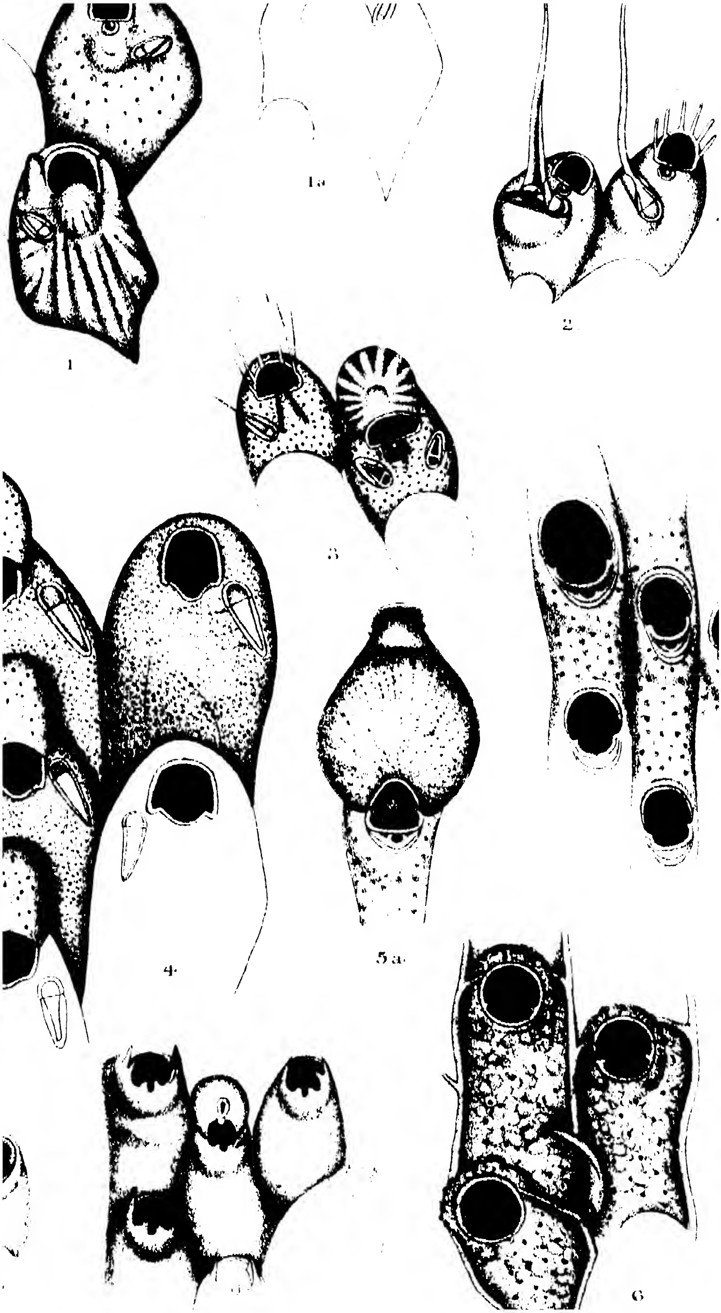
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